A Summary of Sablefish Tagging and Biological Studies Conducted during 1980 and 1981 by the Pacific Biological Station

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A SUMMARY OF SABLEFISH TAGGING AND BIOLOGICAL STUDIES CONDUCTED DURING 1980, AND 1981 BY THE PACIFIC BIOLOGICAL STATION

by

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ABSTRACT

Beamish, R. J., G. A. McFarlane, R. Scarsbrook, D. Chilton, I. Barber, K. Best, A. Cass, and W. Shaw. 1983. A summary of sablefish tagging and biological studies conducted during 1980, and 1981 by the Pacific Biological Station. Can. MS Rep. Fish. Aquat. Sci. 1732: iv + 135 p.

After 5 consecutive years of marking and recapturing sablefish, a total of 115,604 were tagged and 7,576 recaptured. Most fish (88.7%) were recaptured within 200 km of the release area indicating that once adults are recruited into the fishery they tend to remain as localized stocks. There is a slow movement out of the release area but, as yet, there is no indication that adult sablefish behave as one stock. However, because of the longevity of sablefish, the long-term significance of this movement remains to be assessed.

Only 5.5% of the recoveries were made outside the Canadian zone, indicating most fish recruited into the Canadian zone, remain in the zone.

Most recoveries of juveniles are not expected until 1983. Preliminary recapture information shows that juveniles from Queen Charlotte Sound and Hecate Strait that were recaptured at distances greater than 100 km moved offshore and northward.

There was no indication that adult sablefish undergo short-term or long-term directional movements.

The pattern of growth of otoliths from fish injected with oxytetracycline indicates the method of age determination is valid.

Biological information collected during tagging cruises is summarized for sablefish. Descriptions of studies to determine the best dosage of oxytetracycline and escape devices for sablefish traps are also included.

RÉSUMÉ

Beamish, R. J., G. A. McFarlane, R. Scarsbrook, D. Chilton, I. Barber, K. Best, A. Cass, and W. Shaw. 1983. A summary of sablefish tagging and biological studies conducted during 1980, and 1981 by the Pacific Biological Station. Can. MS Rep. Fish. Aquat. Sci. 1732: iv + 135 p.

Après cinq années consécutives de marquage et de reprise de morues charbonnières, 115 604 individus ont été étiquetés et 7 576 repris. La plupart des poissons (88.7%) ont été repris en deçà de 200 km de la zone de remise à l'eau, ce qui indique qu'une fois recrutés, les adultes ont tendance à rester dans des stocks localisés. Il y a un déplacement lent en dehors de la région de remise à l'eau, mais jusqu'ici, il n'y a aucune indication que les morues charbonnières adultes se comportent comme un stock. Cependant, en raison de la longévité de la morue charbonnière, l'importance à long terme de ce déplacement reste à évaluer.

Seulement 5.5% des reprises ont eu lieu à l'extérieur de la zone canadienne, ce qui indique que la plupart des poissons recrutés dans la zone canadienne restent dans cette zone.

La plupart des reprises de juvéniles ne sont pas prévues avant 1983. Les renseignements préliminaires sur les reprises montrent que les juvéniles provenant du détroit de la Reine-Charlotte et du détroit d'Hécate qui ont été repris à des distances supérieures à 100 km se sont déplacés au large et vers le nord.

Il n'y a eu aucune indication que les morues charbonnières adultes entreprennent des déplacements directionnels à court ou à long terme.

Le régime de croissance des otolithes provenant de poissons auxquels on a injecté de l'oxytétracycline indique que la méthode de détermination de l'âge est valable.

L'information biologique recueillie au cours des expéditions d'étiquetage est résumée pour la morue charbonnière. On trouve également des descriptions d'études visant à déterminer le meilleur dosage d'oxytétracycline et de dispositifs d'échappement pour les trappes à morue charbonnière.

INTRODUCTION

The Canadian sablefish (Anoplopoma fimbria) tagging program continued in 1980 and 1981. This report summarizes the tagging information for these years and reviews the results that have been obtained up to December 31, 1981. This is the fourth report on this program. The previous reports summarized the tagging information and results of the 1977, 1978 and 1979 activities (Beamish et al. 1978, 1979, 1980).

The primary purpose of the tagging program is to identify stocks by examining the movement of tagged adult fish. Juveniles from the strong 1977 year-class were tagged in Hecate Strait, Queen Charlotte Sound and mainland inlets (inside waters) to study recruitment to the offshore fishery. In addition, some fish were injected with oxytetracycline (OTC) as part of a study to validate the method of age determination.

The report also summarizes the biological information that was collected during the tagging studies in 1980 and 1981. Tag loss and the effect of the dosage of oxytetracycline on growth and survival are discussed.

The results of a study to develop escape devices for commercial trap gear are discussed. Escape devices are necessary because lost traps continue to fish. An estimate of mortality resulting from lost traps has not been determined, however it is thought to be important.

FISHING METHODS

In 1980, sablefish were captured using three different types of fishing gear. In January, February, March and May, Korean-style traps were used to capture fish on the west coast of the Queen Charlotte Islands (Fig. 1), west coast of Vancouver Island (Fig. 2), Queen Charlotte Sound (Fig. 3, 4) and the major inlets of the mainland coast (Fig. 5). Three vessels were used in these cruises and the number of traps per string, depth and soak times varied with vessel and location. In June and July, a longline vessel equipped with a Mustad Autoliner was used to tag fish off the Queen Charlotte Islands and Dixon Entrance (Fig. 6). Herring was used for bait in both trap and longline fishing. In the September-October cruise to Hecate Strait and Queen Charlotte Sound, a modified Nor-Eastern bottom trawl with a 2.2 cm (stretched mesh) liner was used to capture juvenile sablefish for tagging.

In 1981, three trap vessels and one bottom trawl vessel were used to tag sablefish. In March and June, off the west coast of the Queen Charlotte Islands (Fig. 7), collapsible rectangular wire traps, approximately 85 cm x 85 cm x 2.4 m long, were used in the same general locations (Fig. 8). These two vessels used herring as bait in the traps. The vessel used in the November charter had all Korean-style traps and used squid for bait. The sampling area in this cruise covered the west coast of Vancouver Island, Queen Charlotte Sound and the west coast of the Queen Charlotte Islands with the

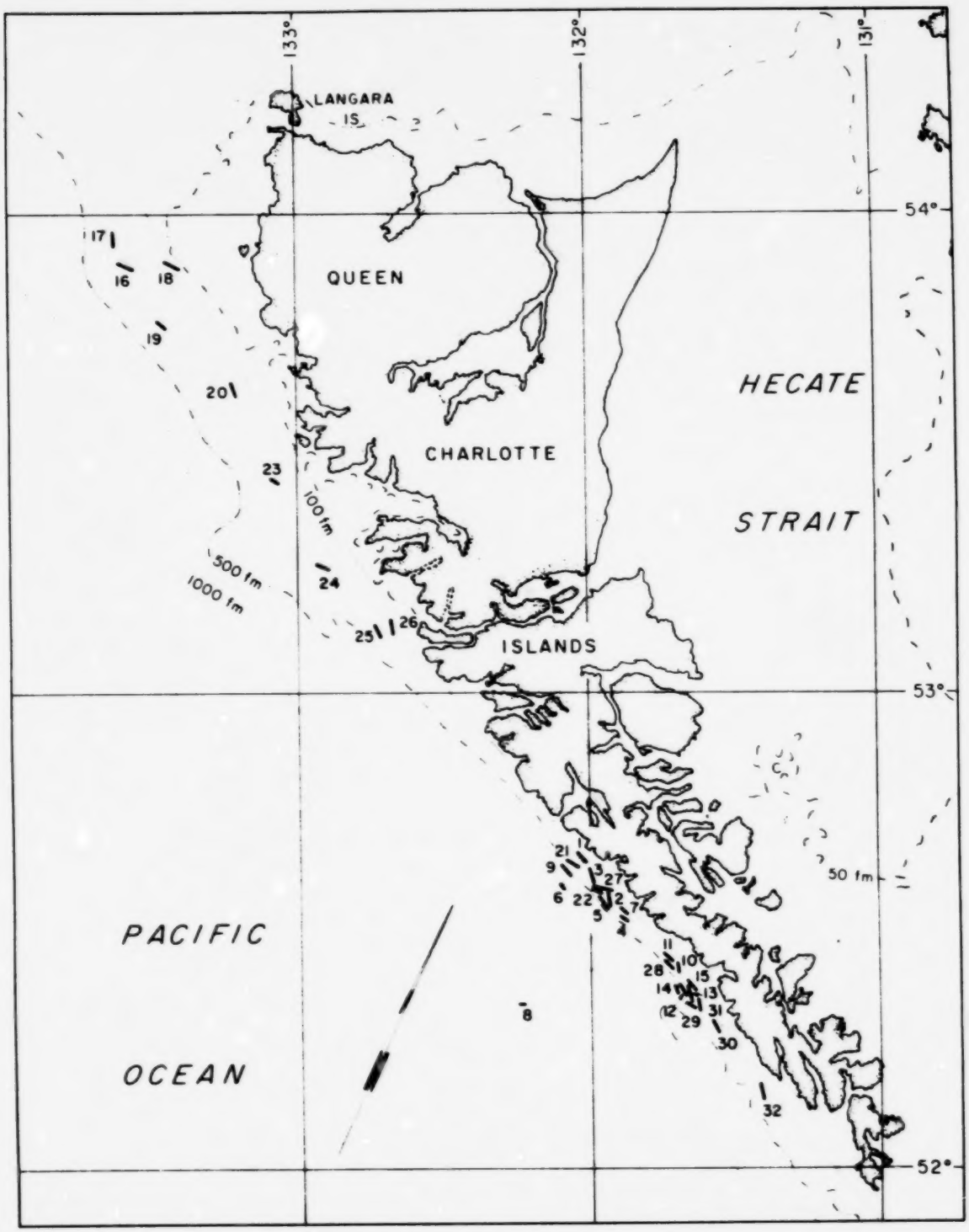


Fig. 1. Set locations off the west coast of the Queen Charlotte Islands, January and February 1980.

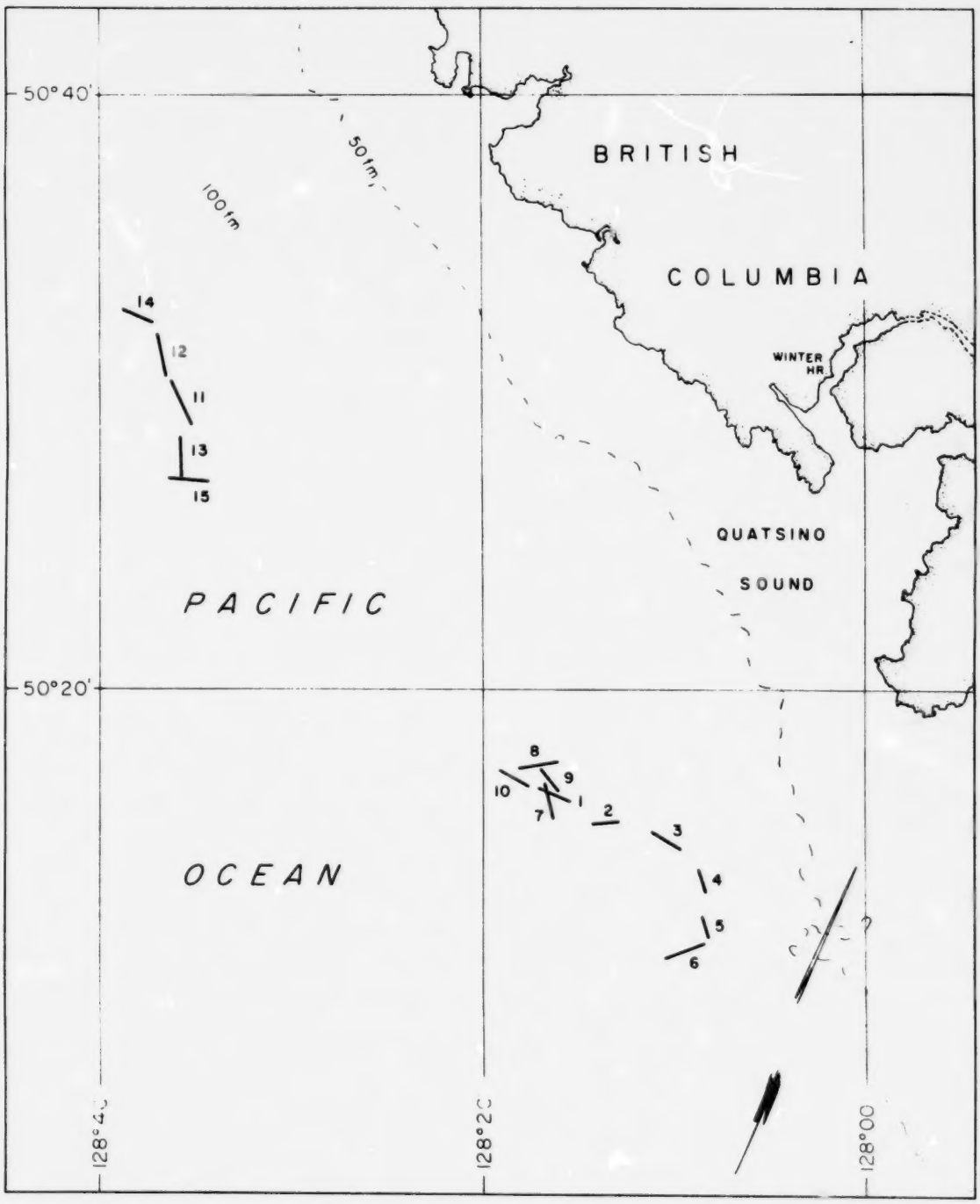


Fig. 2. Set locations off the west coast of Vancouver Island, March 1980.

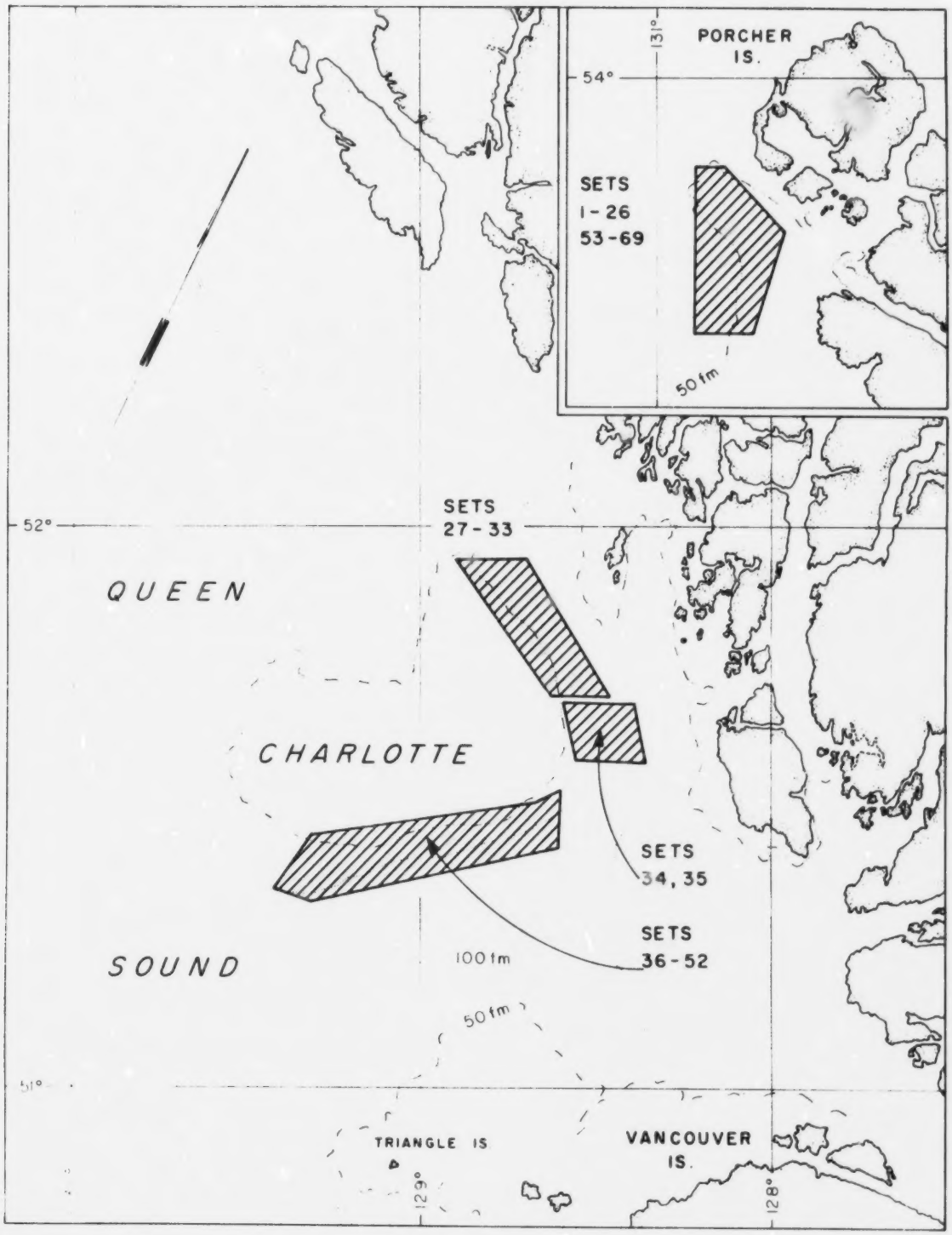


Fig. 3. Set locations for the bottom trawl sets made in September and October 1980.

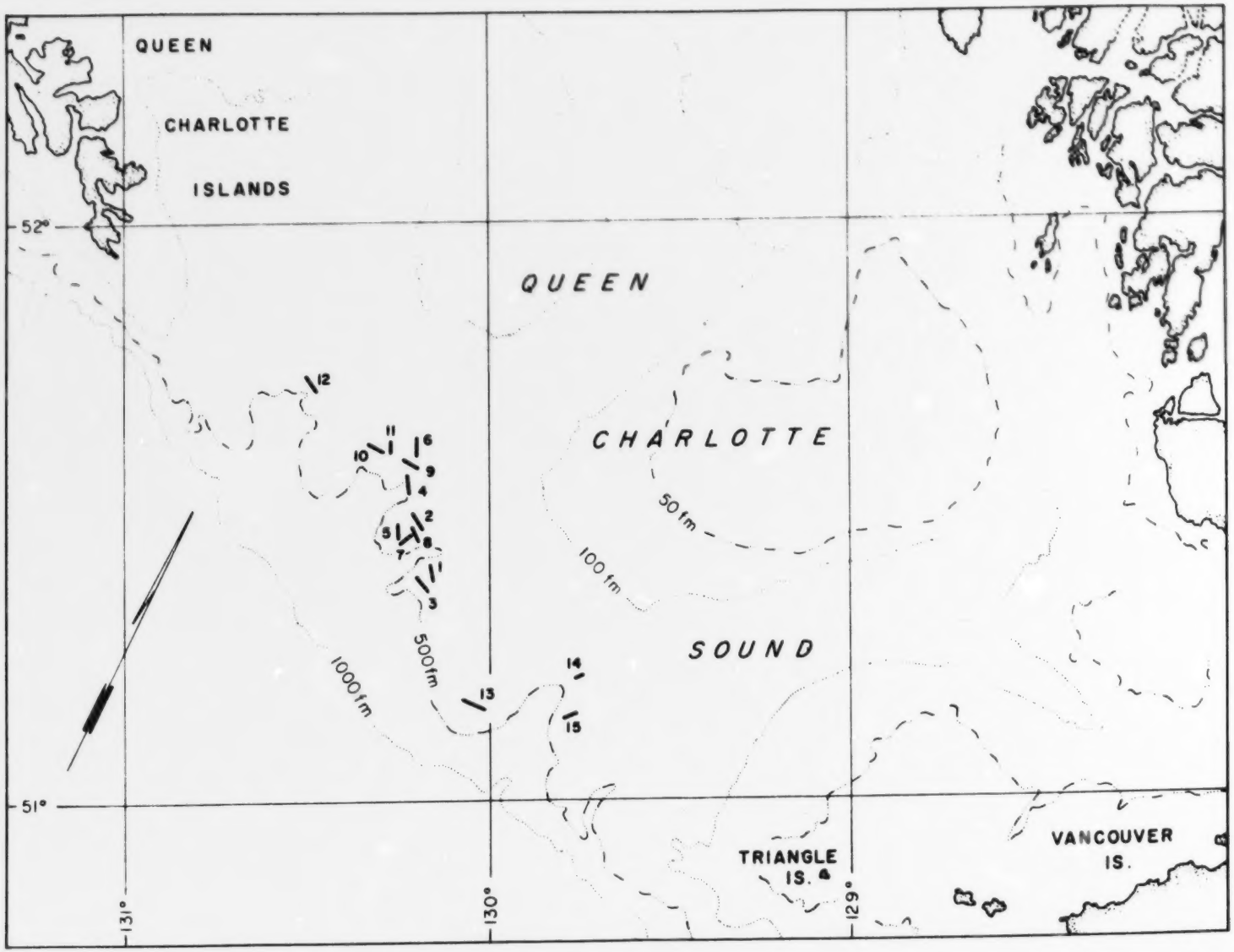


Fig. 4. Set locations in Queen Charlotte Sound, March 1980.

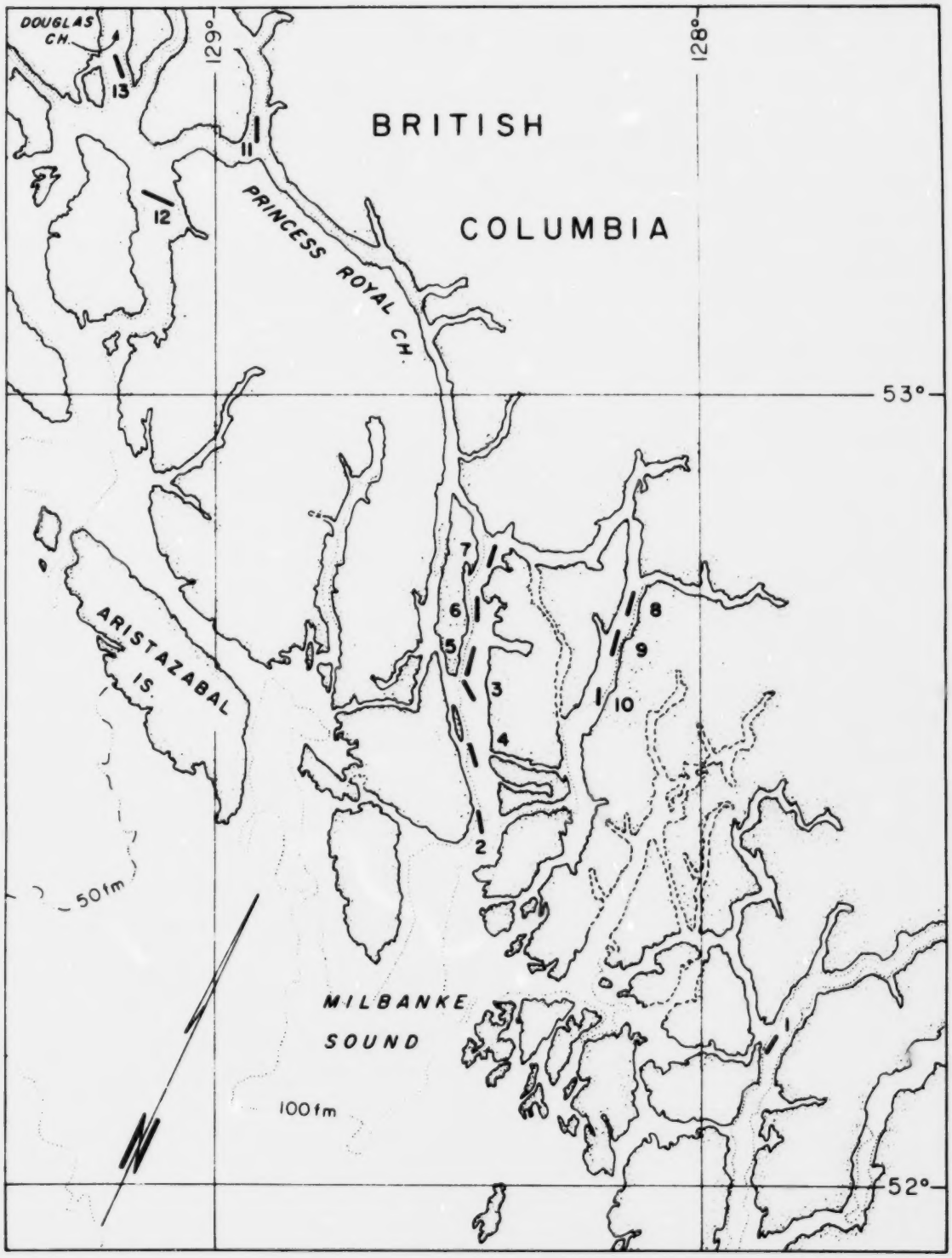


Fig. 5. Set locations in the major inlets of British Columbia, May 1980.

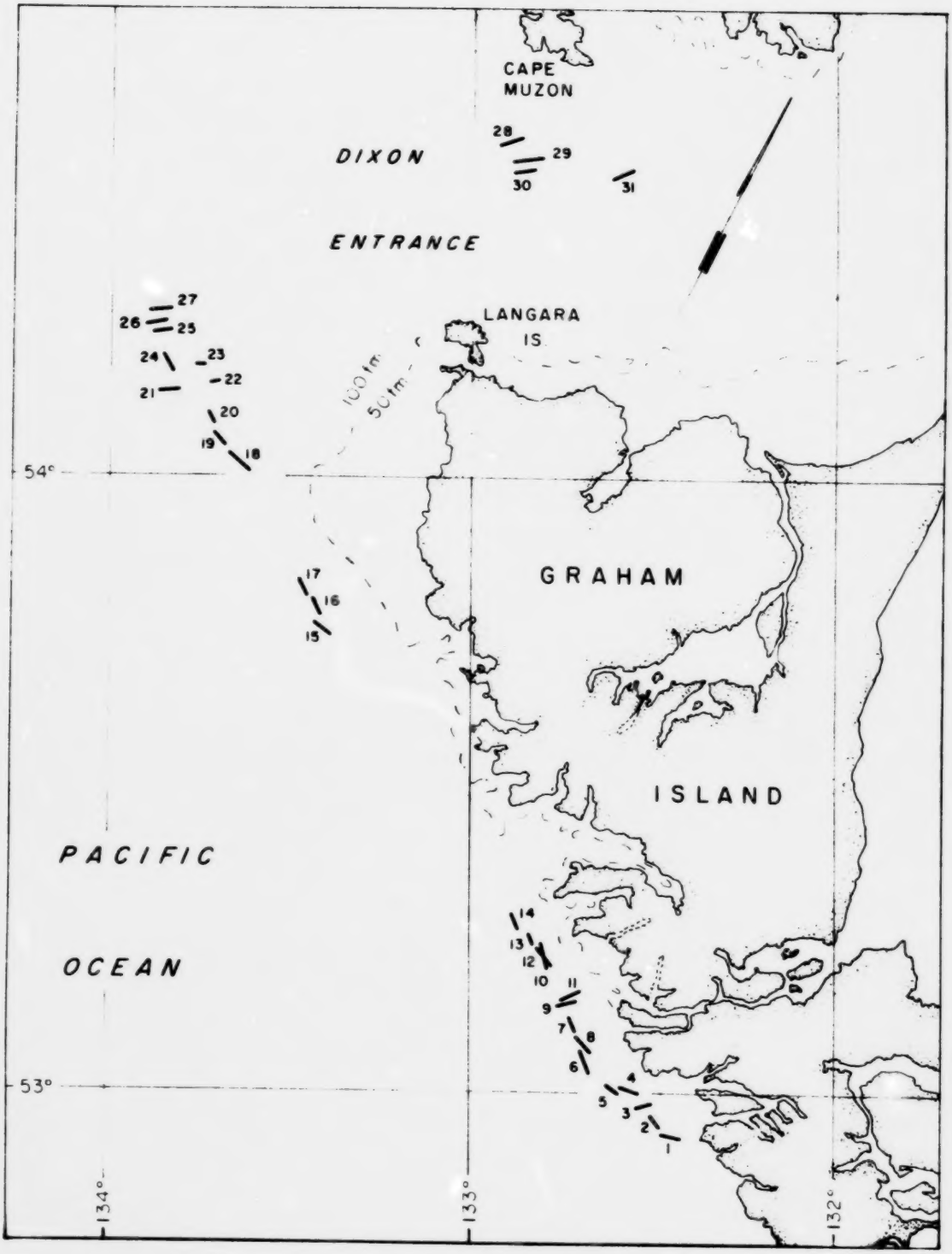


Fig. 6. Set locations off the west coast of the Queen Charlotte Islands and Dixon Entrance, June and July 1980.

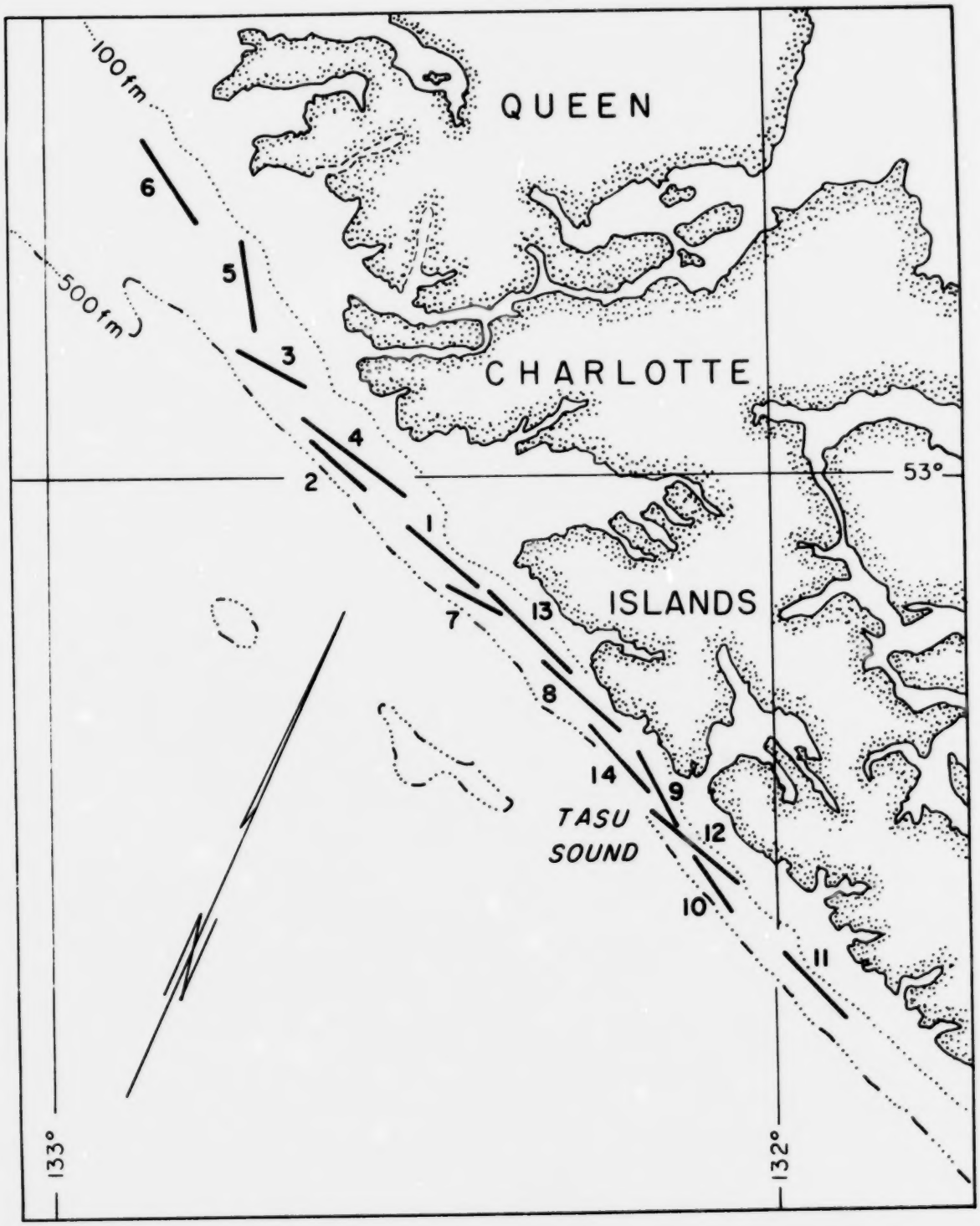


Fig. 7. Set locations off the west coast of the Queen Charlotte Islands, March 1981.

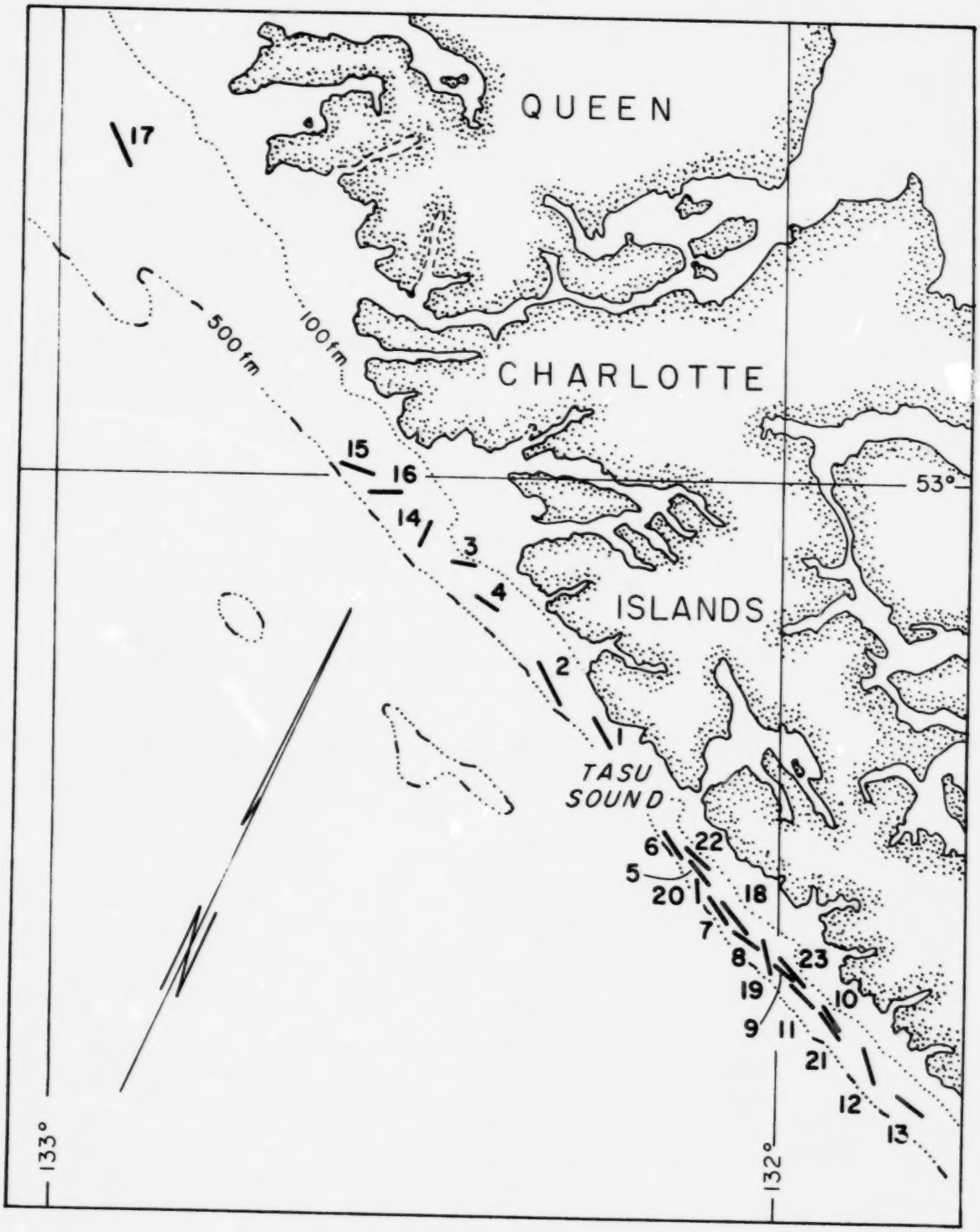


Fig. 8. Set locations off the west coast of the Queen Charlotte Islands, June 1981.

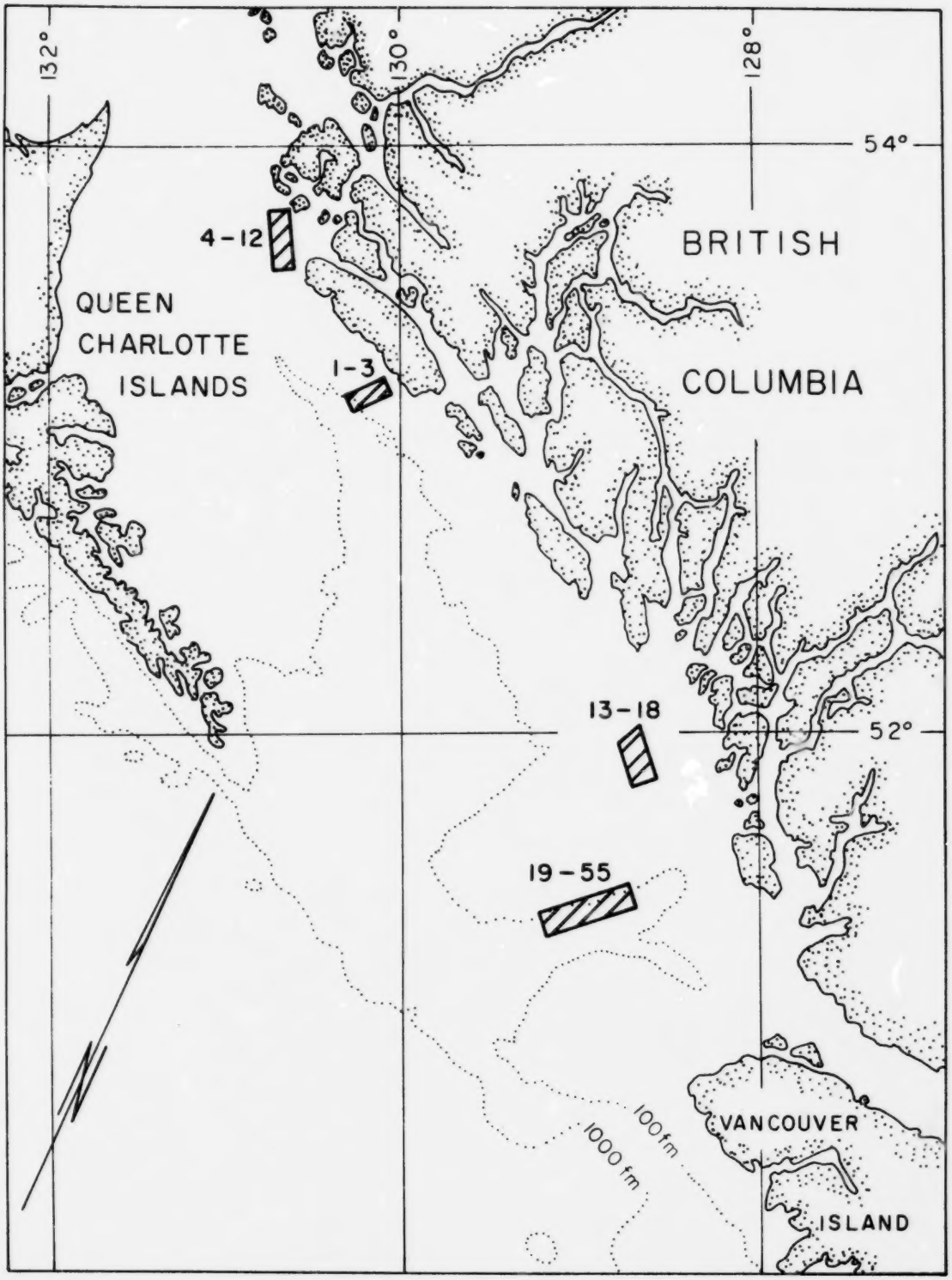


Fig. 9. Set locations for the bottom trawl sets made in August 1981.

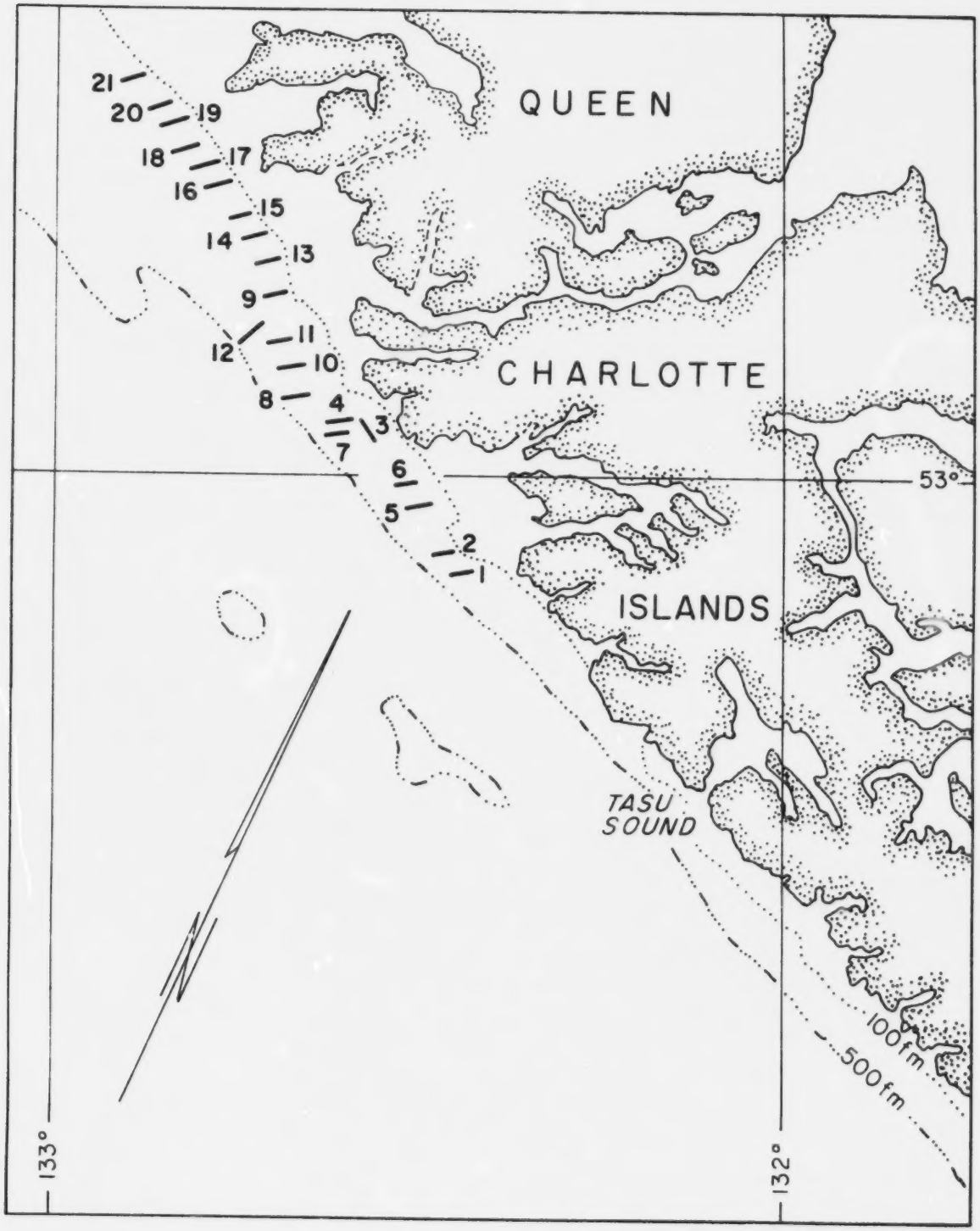


Fig. 10. Set locations off the west coast of the Queen Charlotte Islands, November 1981.

tagging taking place at the latter location (Fig. 10). In August, a Granton bottom trawl was used to capture juvenile sablefish in Hecate Strait and Queen Charlotte Sound (Fig. 9) The methods of handling fish for all tagging cruises were similar to those reported in previous reports (Beamish et al. 1978, 1979, 1980).

TAGGING METHODS

The primary tag used continued to be the Floy FD-68 anchor tag. In 1980, as in other years, approximately 10% of the fish were tagged with a "suture" tag (White and Beamish 1972). This tag is described in previous tagging studies (Beamish et al. 1979). As in previous years, trap-caught fish were transferred directly into holding tanks that had a continuous supply of seawater. Each fish was dipped out, measured for fork length, tagged and then released immediately over the side of the vessel. The majority of fish sounded and were out of sight within seconds. Condition of the fish, and any problems with the tags were recorded. The longline-caught fish were "dipnetted" as they came to the surface of the water and were brought on board in the net. The hook was then carefully removed and the fish put into a holding tank for the tagging procedure. Approximately 30% of longline-caught fish were not tagged due to hook wounds. Anaesthetic was not needed for either the trap- or longline-caught fish.

Trawl-caught juvenile sablefish were anaesthesized prior to tagging using MS 222 (Tricaine Methane Sulfonate). The response to anaesthetic was monitored and fresh seawater was added to the anaesthetic tank if the opercular movements of the fish were thought to be excessively reduced. Fish were tagged with either anchor tags or suture tags. No fish received two tags and no fish had injections of oxytetracycline in 1980.

SAMPLING METHODS

Starting in 1980, sablefish were measured for fork length to the nearest millimetre rather than the nearest centimetre as in previous years. Dead sablefish from the traps were also measured for fork length and if time permitted sex and maturity were determined. All sablefish caught on the longline cruise that were unfit for tagging were sampled for length, sex, and maturity, and otoliths were taken for age determination. Sample lots of fish were measured for length, sex, maturity, weight and age determination. Sample lots were selected that were representative of the catch.

All recovered tagged sablefish were measured for fork length to the nearest millimetre, examined for sex, maturity, stomach contents, abnormal tag wounds or other injuries, and sampled for otoliths. Most recovered fish were frozen before measurements of length were taken.

Age was determined from broken, polished and burnt otoliths as described by Beamish and Chilton (1982).

A list of fishes and major invertebrates captured during the cruises is presented in Table 1. The common names used are those found in Hart (1973). Most rattails and Pacific flatnoses were sexed, measured for length to the nearest cm if the tail was complete and sampled for otoliths. Samples of other species of fish were taken for other investigations.

The time of setting and the water and wind conditions were recorded for each set but have not been included in this report.

OXYTETRACYCLINE (OTC) DOSAGE STUDIES

The validation of an age determination method is essential for the understanding of the biology of any fish. One of the few methods for validating age determination is to inject OTC into a fish so that a mark is deposited in the ageing structure. The most suitable dosage of OTC necessary to produce this mark in sablefish has not been determined experimentally.

During March and June 1981, sablefish captured off the west coast of the Queen Charlotte Islands were tagged, injected with OTC and released as part of a study to determine mortality rates and persistence of the "time mark" associated with varying dosages of OTC. Approximately one quarter were tagged in the routine manner and received an injection of 100 mg OTC/kg of body weight into the peritoneal cavity (Beamish et al. 1978). One quarter were tagged and given the same volume of OTC diluted with 1% saline to produce one quarter of the concentration (25 mg/kg), one quarter were tagged and injected with the same volume of 1% saline solution and one quarter were tagged and not injected.

In November 1981 off the west coast of the Queen Charlotte Islands, one quarter of the sablefish were tagged and given an intraperitoneal injection of 25 mg OTC/kg body weight, one quarter were tagged and given an intraperitoneal injection of 50 mg/kg, one quarter were tagged and given an intraperitoneal injection of 75 mg/kg, and one eighth were tagged and received no injection. In addition, one eighth of the fish were tagged and given an intermuscular injection of 25 mg/kg body weight.

Observations continued on sablefish that received varying dosages of OTC and were held in the laboratory as described in Beamish et al. (1980).

AGE VALIDATION STUDIES

Fish that were injected with OTC in 1977 and 1978 continued to be recaptured in 1980 and 1981. Otolith pairs from many of these recaptured fish were recovered and stored in 50% glycerine in a darkened container. Prior to storage the otoliths were wiped clean of all tissues.

Otoliths were stored for up to 2 yrs when the accumulated sample was examined. One otolith of each pair was examined in a darkened room using a

Table 1. Scientific names and numbers of fish species, other than sablefish, and major invertebrates captured by trap and longline during 1980 and 1981 tagging cruises.

Common name	Scientific name	Trap 1980	Trap 1981[a]	Longline 1980
Arrowtooth flounder	Atherestes stomias	71	110	68
Deepsea sole	Embassichthys bathybius	-	2	-
Dover sole	Microstomus pacificus	15	6	12
Greenland turbot	Reinhardtius hippoglossoides	-	1	-
Pacific halibut	Hippoglossus stenolepis	92	92	36
Petrale sole	Eopsetta jordani	1	1	1
Aurora rockfish	Sebastes aurora	1	-	-
Bocaccio	S. paucispinis	-	-	2
Redbanded rockfish	S. babcocki	59	17	20
Rougheye rockfish	S. aleutianus	34	126	866
Sharpchin rockfish	S. zacentrus	-	1	-
Shortraker rockfish	S. borealis	167	101	45
Silvergray rockfish	S. brevispinis	-	-	2
Splitnose rockfish	S. diploproa	1	-	-
Yelloweye rockfish	S. ruberrimus	5	-	1
Yellowtail rockfish	S. flavidus	-	-	4
Rockfishes (discarded)	Sebastes sp.	17	-	-
Shortspine thornyhead	Sebastolobus alascanus	43	107	576
Lingcod	Ophiodon elongatus	7	7	-
Pacific cod	Gadus macrocephalus	-	-	4
Pacific flatnose	Antimora microlepis	10	4	1
Brotylid	Parabassiogigas grandis	3	-	-
Filamented rattail	Coryphaenoides filifera	-	21	-
Pectoral rattail	C. pectoralis	9	18	93
Roughscale rattail	C. acrolepis	25	1	31
Rattails (discarded)	Coryphaenoides sp.	5	2	1
Unidentified eelpouts	Zoarcidae	4	-	-
Unidentified sculpin	Cottidae	1	-	-
Unidentified snailfish	Cyclyopteridae	-	1	-
Blue shark	Prionace glauca	-	-	4
Ratfish	Hydrolagus colliei	3	-	29
Skate	Raja sp.	-	1	137
Spiny dogfish	Squalus acanthias	124	1	4
Hagfish	Eptatretus stouti	Present	Present	-
Box crab	Lithodes couesi	36	47	-
Tanner crab	Chionoecetes tanneri	-	114	1
Unidentified crabs	Chionoecetes (2 sp.)	101	-	-
	Unidentified	67	-	-
Octopus		8	6	-

[a]Includes two of the three trap cruises.

Leitz Dialux 20 microscope equipped with an ultraviolet light. If an OTC mark was present (glowing yellow line), the otolith was broken dorso-ventrally through the nucleus and the broken surface examined. The position of the OTC mark was noted and the distance from the distal edge of the mark to the edge of the otolith section was measured. The section was then burnt (Beamish and Chilton 1982) and the age was determined. The position of the OTC mark was identified using the previous measurements since the burning destroyed the mark. The number of annuli that formed distal of the mark were then counted. For some sections it was not necessary to burn the otolith as the annuli were distinguishable using the reflected ultraviolet light.

Only the otoliths from fish that had been at liberty for three or more years after tagging and injection were examined. In most cases there was very little otolith growth during this period. Fish that had been at liberty for 1 or 2 years frequently had grown very little making it difficult to identify annuli. When the reader examined the area distal of the OTC mark, the reader was aware that there could be either 3 or 4 annuli. In the early stages of this validation study we were interested in studying otolith growth as well as validating the age determination method. Because the annual growth zones are very narrow and sometimes difficult to identify we wanted to be certain that these zones formed annually, thus many otoliths were examined with a prior knowledge of the years at liberty.

A smaller sample was examined such that the accuracy of the determination could be estimated. The age from one broken and burnt section was determined and the age from the nucleus to the OTC mark was determined from the remaining half. The difference in these two determinations was then compared to the time at liberty after tagging and marking.

ESCAPE DEVICES

Two escape openings were tested on two separate charters off the west coast of the Queen Charlotte Islands. One opening was an 8-in slash that is used by many commercial fishermen, and consists of cutting 3-4 meshes in a straight line. The second opening was a 12-in panel made by cutting three sides of a rectangle to give a 12-in diagonal opening.

Traps were baited with herring and then set, and the entire string was left on the bottom for a period of approximately 10-15 days.

RESULTS AND DISCUSSION

A total of 30,065 sablefish were tagged in 1980 and 22,737 in 1981 (Table 2). A total of 115,604 sablefish have been tagged in this study as of December 31, 1981, 55,984 of which were juveniles from mainland inlets,

Hecate Strait or Queen Charlotte Sound ('inside waters'). In 1980, 1609 fish received double tags (Table 2). A total of 1251 juveniles received only a suture tag. In 1981, no fish were double tagged.

All OTC injections were suspended in 1978 when it was determined that the dosage was causing mortality. In 1981, 10,431 fish were tagged and injected with varying concentrations of OTC as part of the study to determine an effective and safe dosage of OTC for sablefish.

Tag numbers and tagging locations for all cruises in 1980 and 1981 are recorded in Appendix Tables 1-10.

As of December 31, 1981, 7576 tagged sablefish have been recovered (Tables 3, 4). The total percent recovery is 6.6% or 10.7% if juveniles tagged in the inside waters are excluded (Tables 3, 4). Recovery rates that exclude juveniles tagged in these inside waters probably are more representative since these juveniles are only beginning to be recruited into the "offshore" commercial fishery. Also, if the fish injected with a dosage of 100 mg/kg of OTC are excluded because of the increased mortality, then the percent recovery becomes 15.0%.

The recovery percentage of 6.6% is higher than that observed for any other major sablefish tagging study (Wespestad et al. 1978, 2.9%; Sasaki 1979, 1.6%; Phillips 1969, 0.22-4.63%) and the percentage in this study obviously will increase with time. The percentage is high relative to other studies because the relatively small number of fishermen in the Canadian fishery are extremely supportive of the study and make every effort to return fish. We suspect that care during the tagging operation and the tendency for fish to remain in the release area are also important reasons for the high rate of returns.

Recovery percentages vary among release areas, treatments and time at liberty (Table 5). The highest percent recovery of 23.3% is for the July 1977 cruise off the west coast of the Queen Charlotte Islands. The lowest percentages for fish that have been at liberty for more than 2 yrs is 3.0% for fish injected with OTC and released off the west coast of Vancouver Island (Tables 3, 5). Fig. 11 shows that, as expected, most of the recoveries for these two cruises have been made. However, the slopes of both curves are still declining and a projected asymtotic recovery percentage is 25% for the high recovery study (Fig. 11A). No asymtotic recovery percentage is projected for the low recovery study as cumulative recoveries are continuing to increase linearly (Fig. 11B).

In a few cases the recovery percentage was very low as a result of either a small number of releases or releases in an area that is not fished commercially.

Fish that were tagged in mainland inlets in May 1980 were a mixture of juveniles and adults (Fig. 12). The recovery percentage is high (Table 4) because of a small local fishery and indicates that many fish have remained in the release area.

The recovery percentage of most juveniles remains low (Table 4). Juveniles that were tagged in Queen Charlotte Sound and Hecate Strait were

almost entirely from the 1977 year-class. Since these fish were small and tended to remain in the inside waters, they were not fished commercially. They were occasionally caught by bottom trawlers as incidental catches. It is anticipated that many of these fish will be recruited into the offshore fishery during 1983. The recoveries in 1983 may make it possible to determine some of the reasons for the relatively low recovery percentages from 1980 to 1982.

The lower recovery rate of fish injected with OTC reported previously (Beamish et al. 1978, 1979, 1980) continued. For example, in the May 1978 release, only 5.4% of the injected fish have been recovered compared to a recovery of 33.7% of the fish not injected on this cruise (Table 3). Thus there is little doubt that a dosage of 100 mg/kg caused increased mortality. The total percent recovery of non-injected fish is significantly higher than injected fish tagged and released in the same year (t-test, $P<0.05$).

Tagged fish released off Vancouver Island were recovered from California to the Aleutians (Fig. 13). Of the total recoveries of the releases from 1977-1981, 81.3% have been recovered off Vancouver Island, 2.1% have been recovered in the United States zone south of Vancouver Island and 1.7% have been recovered in the United States zone north of Dixon Entrance. The remaining 14.9% have been recovered in the Canadian zone in Queen Charlotte Sound and off the Queen Charlotte Islands. It is interesting that more fish (7.7%) have been recovered in Queen Charlotte Sound than off the west coast of the Queen Charlotte Islands (1.3%) even though catches have been larger off of the Queen Charlotte Islands than in Queen Charlotte Sound.

Fish tagged and released off the west coast of the Queen Charlotte Islands appeared to show more complex movements (Fig. 14). Most fish (81.7%) were recovered off the west coast of the Queen Charlotte Islands. They were also recovered in the United States zone from Oregon to the Aleutians. These fish have not moved as far south but have moved slightly further east off the Aleutians than fish released off Vancouver Island. The percentages recovered in the United States zone north of Dixon Entrance are higher (6.6%) than recoveries from Vancouver Island releases and lower (0.3%) in the United States zone south of Vancouver Island. In contrast to recoveries of Vancouver Island releases, fish tagged off the Queen Charlotte Islands were recovered in Dixon Entrance and Northern Hecate Strait. There was a greater percentage recovered off Vancouver Island (1.9%) than Vancouver Island releases recovered off the Queen Charlotte Islands despite the larger catches off the Queen Charlotte Islands.

Fish tagged and released in Queen Charlotte Sound (Fig. 14) were recovered in most areas where recoveries were reported.

Distance travelled by tagged fish was summarized in three groups, less than 50 km, 50-200 km, and greater than 200 km. The selection of these groups had no particular significance other than that 50 km would obviously indicate very limited movement. Since commercial vessels often travelled approximately 100 to 200 km during one trip, we have used 200 km to indicate major movements out of a fishing area. In most cases fishermen report their recoveries to us by their Loran bearings.

Table 2. Tagging effort from 1977 to December 31, 1981.

Release area and date	No. of fish released with suture tag only	Total no. of fish tagged	No. (%) of fish double tagged
Queen Charlotte Islands July 77	0	5,158	516 (10.0)
Vancouver Island Sept 77	0	5,505	510 (9.3)
Queen Charlotte Islands May 78	0	5,284	520 (9.8)
Vancouver Island-Queen Charlotte Sound June 78	0	5,465	533 (9.7)
Queen Charlotte Islands Oct 78	0	121	0
Vancouver Island May 79	118	9,111	751 (8.2)
Queen Charlotte Islands June 79	39	6,339	635 (10.0)
Queen Charlotte Islands Aug 79	0	282	0
Queen Charlotte Sound-Hecate Strait Oct 79	2,216	12,983	0
Queen Charlotte Sound-Hecate Strait Nov 79	2,300	12,528	0
Departure Bay Dec 79	26	26	0
Queen Charlotte Islands Feb 80	0	1,538	104 (6.8)
Vancouver Island Mar 80	0	4,703	388 (8.3)
Queen Charlotte Sound Mar 80	0	3,110	308 (9.9)
Inlets May 80	0	7,019	526 (7.5)
Queen Charlotte Islands July 80	0	2,547	283 (11.1)
Queen Charlotte Sound-Hecate Strait Oct 80	1,251	11,148	0
Queen Charlotte Islands Mar 81	0	3,112	0
Queen Charlotte Islands June 81	0	2,908	0
Queen Charlotte Sound-Hecate Strait Aug 81	0	12,306	0
Queen Charlotte Islands Nov 81	0	4,411	0
Total	5,950	115,604	5,074 (9.1)[a]

[a]Percent includes only those cruises in which fish were double tagged.

Table 3. Releases and recaptures of tagged sablefish released offshore[a] as of December 1981.

Release area and date		Number released		Number recovered %[b]							
				Non-injected				Injected			
		Non-injected	Injected	Total		1980	1981	Total		1980	1981
Queen Charlotte Islands	July 77	5,158	-	1,204	(23.3)	138	85	-		-	-
	May 78	866[c]	4,418[d]	292[e]	(33.7)	59	32	240[f]	(5.4)	46	25
	Oct 78	121	-	21	(17.4)	3	3	-		-	-
	June 79	6,339	-	1,390	(21.9)	587	328	-		-	-
	Aug 79	282	-	21	(7.4)	12	8	-		-	-
	Feb 80	1,538	-	151	(9.8)	79	72	-		-	-
	July 80	2,547	-	116	(4.1)	27	89	-		-	-
	Mar 81	855	2,257	35	(4.2)	-	35	83	(3.7)	-	83
	June 81	728	2,180	27	(3.7)	-	27	77	(3.5)	-	77
	Nov 81	535	3,876	-		-	-	-		-	-
Strait of Georgia	Dec 79	26	-	1		-	1	-		-	-
Vancouver Island	Sept 77	226	5,279	1	(0.4)	1	-	160	(3.0)	62	39
	May 79	9,111	-	1,204	(13.2)	655	207	-		-	-
	Mar 80	4,703	-	560	(11.9)	335	225	-		-	-
Vancouver Island-Queen Charlotte Sound	June 78	2	5,463	0		-	-	418	(7.7)	180	68
Queen Charlotte Sound	Mar 80	3,110	-	399	(12.8)	153	246	-		-	-
Total		36,147	23,473	5,422	(15.0)	2,049	1,358	978	(4.2)	288	292

[a]Offshore waters are defined as all waters off the west coasts of Vancouver Island, Queen Charlotte Islands and west of Queen Charlotte Sound.

[b]Does not include 23 fish with unknown release date.

[c]Includes 19 fish recaptured from July 1977 releases.

[d]Includes 55 fish recaputred from July 1977 releases.

[e]Includes 10 of the 19 recaptures ([c]) for the second time.

[f]Includes 4 of the 55 recaptures caught for the second time.

Table 4. Releases and recaptures of tagged sablefish in inshore waters[a] as of December 31, 1981.

Release area and date		Number released	Number recaptured (%)		
			1980	1981	Total
Queen Charlotte Sound-Hecate Strait	Oct 79	12,983	88	46	146 (1.1)
	Nov 79	12,528	58	18	80 (0.6)
	Oct 80	11,148	8	67	75 (0.7)
	Aug 81	12,306	-	40	40 (0.3)
Inlets	May 80	7,019	480	274	754 (10.7)

[a]Inshore waters is used to include Hecate Strait, Queen Charlotte Sound and connecting waters, mainland inlets and the Strait of Georgia.

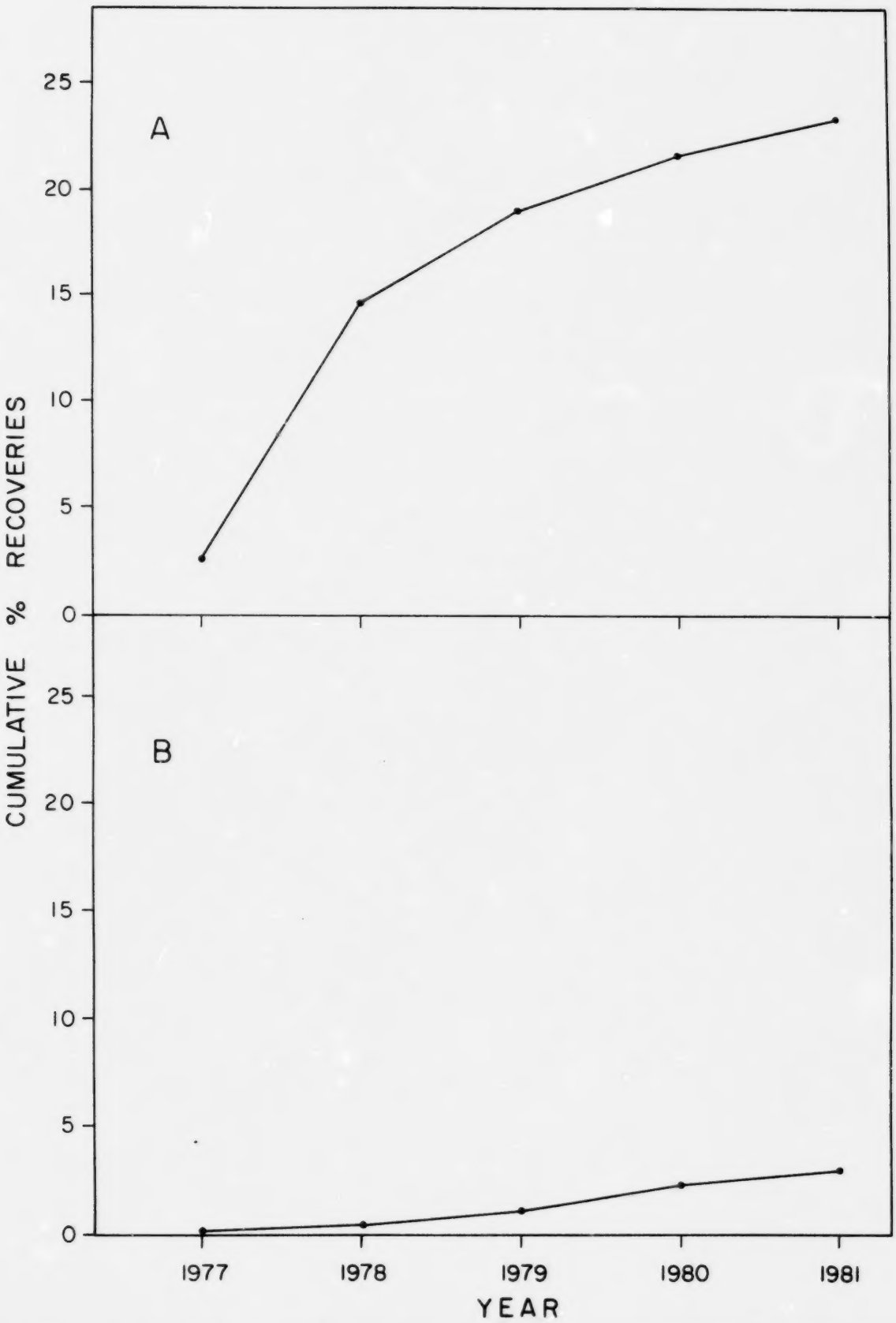
Table 5. Recovery percentages as of December 31, 1981 for all tagged sablefish.

Release area and date		No. (%) of tagged fish recovered	No. (%) of double tagged fish recovered				Maximum time at liberty (days)
			Total	Both tags	Suture only	Anchor only	
Queen Charlotte Islands	July 77	1,204 (23.3)	125 (10.4)	120 (96.0)	5 (4.0)	-	1597
Vancouver Island	Sept 77	161 (3.0)	16 (9.6)	12 (75.0)	1 (6.3)	3 (18.7)	1476
Queen Charlotte Islands	May 78	532 (10.1)	30 (5.6)	28 (93.3)	1 (3.3)	1 (3.3)	1283
Vancouver Island-Queen Charlotte Sound	June 78	418 (7.6)	42 (10.0)	36 (85.7)	1 (2.4)	5 (11.9)	1197
Queen Charlotte Islands	Oct 78	21 (17.4)	-	-	-	-	1088
Vancouver Island	May 79	1,204 (13.2)	106 (8.8)	91 (85.8)	10 (9.4)	5 (4.7)	875
Queen Charlotte Islands	June 79	1,390 (21.9)	159 (11.4)	135 (84.9)	15 (9.4)	9 (5.7)	923
Queen Charlotte Islands	Aug 79	21 (7.4)	-	-	-	-	783
Queen Charlotte Sound-Hecate Strait	Oct 79	146 (1.1)	-	-	-	-	791
Queen Charlotte Sound-Hecate Strait	Nov 79	80 (0.6)	-	-	-	-	766
Departure Bay	Dec 79	1 (3.8)	-	-	-	-	428
Queen Charlotte Islands	Feb 80	151 (9.8)	12 (7.9)	11 (91.7)	1 (8.3)	-	678
Vancouver Island	Mar 80	560 (11.9)	35 (6.3)	32 (91.4)	1 (2.9)	2 (5.7)	636
Queen Charlotte Sound Inlets	Mar 80	399 (12.8)	33 (8.3)	28 (84.8)	3 (9.1)	2 (6.1)	634
Queen Charlotte Islands	May 80	754 (10.7)	50 (6.6)	38 (76.0)	7(14.0)	5 (10.0)	587
Queen Charlotte Sound-Hecate Strait	July 80	116 (4.6)	10 (8.6)	9 (90.0)	-	1 (10.0)	514
Queen Charlotte Islands	Oct 80	75 (0.7)	-	-	-	-	447
Queen Charlotte Islands	Mar 81	118 (3.9)	-	-	-	-	276
Queen Charlotte Islands	June 81	104 (3.6)	-	-	-	-	174
Queen Charlotte Sound-Hecate Strait	Aug 81	40 (0.3)	-	-	-	-	124
Queen Charlotte Islands	Nov 81	0	-	-	-	-	-
Unknown release area		81					
Total		7,576 (6.6)	618 (8.1)	540 (87.4)	45 (7.3)	33 (5.3)	

Fig. 11. Cumulative percent recovery of tagged sablefish.

A. Non-injected fish released in July 1977 (Queen Charlotte Islands)

B. Injected fish released in September 1977 (Vancouver Island)


A
B
25
20
15
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CUMULATIVE % RECOVERIES
1977
1978
1979
1980
1981
YEAR

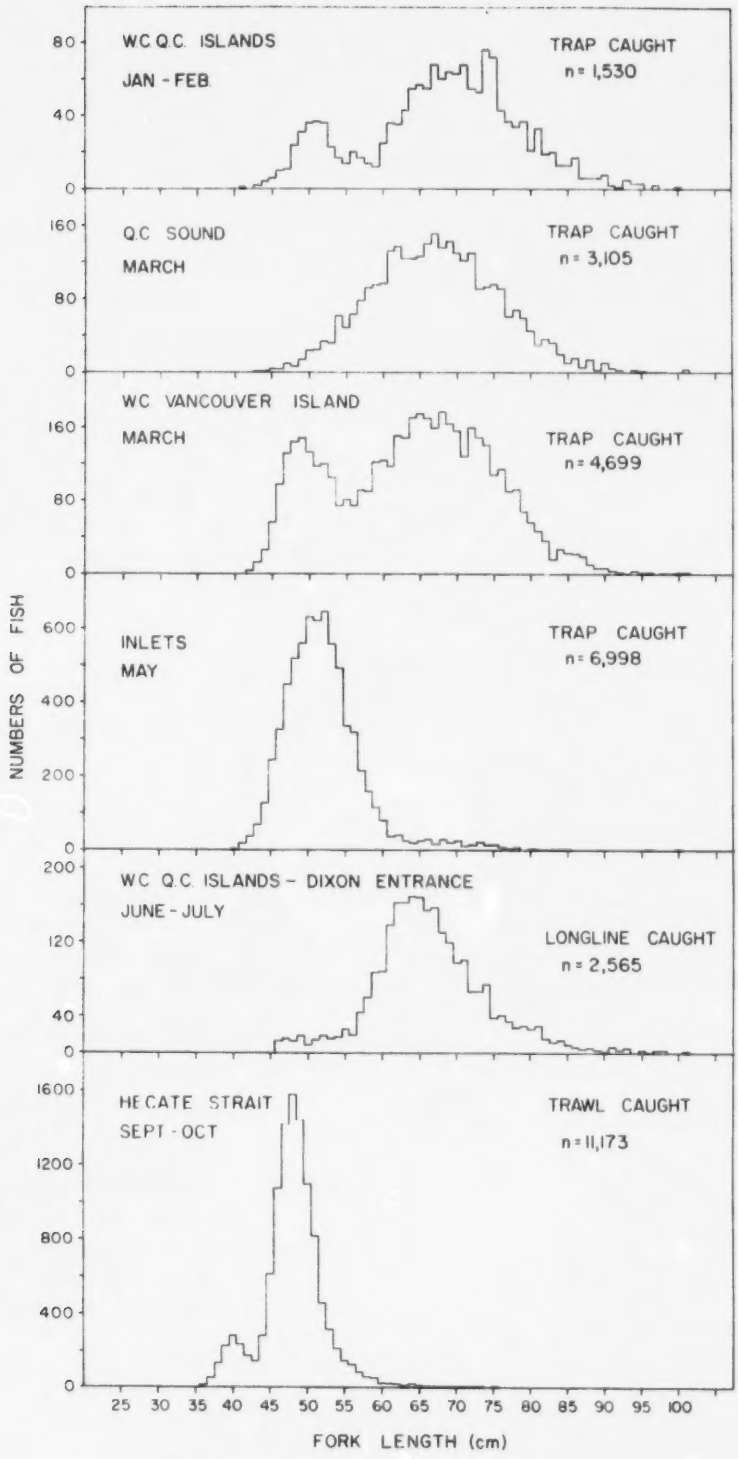


Fig. 12. Length frequencies of sablefish tagged in 1980.

As of December 31, 1981, 6337 (88.7%) recaptures had been made within 200 km of the release area (Table 6). The average net movement for all recaptures was 141.7 km. Thus, the previous conclusion (Beamish et al. 1980) that sablefish do not move substantially from the release area, remains unchanged. There were some substantial movements (Table 6) but they remain in the minority.

Recaptures within 50 km from a particular tagging cruise declined with years at liberty, while recoveries at distances greater than 50 km increased (Table 7). A similar trend occurred in the 50-200 km range (Table 7). In 1980 and 1981, releases showed a tendency to move out of the release area, faster than in previous years. While long-term movement out of the release area occurs (Table 7), the high percent of recoveries in the immediate release area indicates a large percent of blackcod undergo no extensive short-term or long-term movements. There is a trend for a slow movement out of the release area.

Recoveries can be quite close to the exact location of release. The net movement from exact release site has been examined for one cruise (Fig. 16, Table 8). Over a period of 5 yrs the percent recovered within 20 km of the release area averaged 50%.

Fish that were tagged in the inside waters moved at a greater rate than those released from the offshore areas. This may indicate a tendency for juveniles to move offshore or be a consequence of the recovery effort that is almost entirely offshore.

Recaptures of the juveniles (1977 year-class) tagged in the inside waters in 1980 and 1981 indicated that while there has been some movement to offshore areas (Fig. 15) the recovery percentage remains low. While most recoveries have been made in the area of release, recoveries have been made in Hecate Strait, Queen Charlotte Sound, west coast of the Queen Charlotte Islands, and west coast of Vancouver Island. Of fish that migrated more than 200 km, 72% have been recovered in the Canadian zone and 28% in the United States zone. Of fish that have moved into the United States zone (6.9% of total juvenile recoveries) 97.3% have been recovered north of Dixon Entrance and only 2.7% have been recovered south of Vancouver Island. There is a definite northern movement of some juveniles but the movement represents only a small percentage of the total recoveries.

As mentioned, it is expected that juveniles will be recruited to the offshore fishery beginning in 1982. Thus the anticipated increased number of recovered tagged fish should clarify any directional movements.

Directional movement was studied by comparing the number of fish that moved north and south across boundaries for Canadian statistical areas. In Canada, a major statistical area ranges from approximately 100 to 200 km in latitude. Since longer-term movements were being examined, only the movements of adult fish that were tagged in 1977 and 1978 were examined. Juveniles tagged in 1979 were examined since large numbers of juvenile sablefish were not tagged until 1979. In the Charlotte area, 6% moved north and 3% south (Tables 9, 10). In the Vancouver area, fish moved north and south (Tables 11, 12). As mentioned, juveniles also tended to move north rather than south (Table 13). It does appear that the trend for more fish to move north rather

Table 6. Number and percent of sablefish recovered at various distances from the release areas.

Release area and date	Minimum distance travelled[a] (%)			Maximum distance travelled (km)	Mean distance travelled (km)
	<50 km	50-200 km	>200 km		
Queen Charlotte Islands July 77	808 (68.0)	244 (20.5)	137 (11.5)	3280	128
Vancouver Island Sep 77	99 (65.6)	32 (21.2)	20 (13.2)	2001	117
Queen Charlotte Islands May 78	381 (73.0)	87 (16.7)	54 (10.3)	2474	109
Vancouver Island-Queen Charlotte Sound June 78	307 (76.6)	47 (11.7)	47 (11.7)	2113	107
Queen Charlotte Islands Oct 78	13 (61.9)	5 (23.8)	3 (14.3)	611	89
Vancouver Island May 79	925 (81.7)	118 (10.4)	89 (7.9)	2947	67
Queen Charlotte Islands June 79	926 (72.2)	198 (15.4)	158 (12.3)	2446	102
Queen Charlotte Islands Aug 79	13 (68.4)	3 (15.8)	3 (15.8)	1112	178
Queen Charlotte Sound-Hecate Strait Oct 79	75 (52.8)	33 (23.2)	34 (23.9)	2622	269
Queen Charlotte Sound-Hecate Strait Nov 79	22 (29.7)	30 (40.5)	22 (29.7)	1964	382
Departure Bay Dec 79	1(100.0)	-	-	7	7
Queen Charlotte Islands Feb 80	54 (38.3)	57 (40.4)	30 (21.3)	1844	204
Vancouver Island Mar 80	394 (76.2)	77 (14.9)	46 (8.9)	1918	70
Queen Charlotte Sound Mar 80	302 (85.3)	34 (9.6)	18 (5.1)	1742	61
Inlets May 80	650 (87.4)	27 (3.6)	67 (9.0)	2974	76
Queen Charlotte Islands July 80	81 (71.7)	16 (14.1)	16 (14.2)	1223	113
Queen Charlotte Sound-Hecate Strait Oct 80	24 (32.9)	22 (30.1)	27 (37.0)	2428	499
Queen Charlotte Islands Mar 81	65 (53.2)	28 (23.0)	29 (23.8)	1909	178
Queen Charlotte Islands June 81	86 (81.9)	15 (14.3)	4 (3.8)	1195	50
Queen Charlotte Sound-Hecate Strait Aug 81	36 (87.8)	2 (4.9)	3 (7.3)	269	28
Queen Charlotte Islands Nov 81	-	-	-	-	-
Total	5,262 (73.7)	1,075 (15.0)	807 (11.3)		

[a]Does not include fish of unknown recapture area.

Table 7. Recoveries of sablefish at various distances from release areas off the west coast of the Queen Charlotte Islands for each year after release.

Tagging year	Recovery year	Total numbers recovered	% (no.) recoveries from release area		
			<50 km (no.)	50-200 km (no.)	>200 km (no.)
1977	1977	132	87.9 (116)	9.1 (12)	3.0 (4)
	1978	624	77.9 (486)	18.1 (113)	4.0 (25)
	1979	221	49.8 (110)	25.8 (57)	24.4 (54)
	1980	133	48.1 (64)	27.8 (37)	24.1 (32)
	1981	81	42.0 (34)	30.9 (25)	27.1 (22)
1978	1978	209	92.3 (193)	7.2 (15)	0.5 (1)
	1979	176	68.2 (120)	20.4 (36)	11.4 (20)
	1980	101	54.4 (55)	21.8 (22)	23.8 (24)
	1981	59	47.5 (28)	32.2 (19)	20.3 (12)
1979	1979	472	81.1 (383)	13.1 (62)	5.7 (27)
	1980	511	64.0 (327)	19.8 (101)	16.2 (83)
	1981	321	72.6 (233)	11.5 (37)	15.9 (51)
1980	1980	92	55.4 (51)	28.3 (26)	16.3 (15)
	1981	162	52.5 (85)	28.4 (46)	19.1 (31)
1981	1981	229	66.4 (152)	17.9 (41)	15.7 (36)

Table 7 (cont'd). Recoveries of sablefish at various distances from release areas off the west coast of Vancouver Island for each year after release.

Tagging year	Recovery year	Total numbers recovered	% (no.) recoveries from release area					
			<50 km	(no.)	50-200 km	(no.)	>200 km	(no.)
1977	1977	6	66.7	(4)	33.3	(2)	-	(0)
	1978	13	30.8	(4)	61.5	(8)	7.8	(1)
	1979	38	57.9	(22)	18.4	(7)	23.7	(9)
	1980	62	79.0	(49)	12.9	(8)	8.1	(5)
	1981	33	63.6	(21)	21.2	(7)	15.2	(5)
1978a	1978	22	81.8	(18)	9.1	(2)	9.1	(2)
	1979	143	70.6	(101)	14.0	(20)	15.4	(22)
	1980	169	82.8	(140)	7.7	(13)	9.5	(16)
	1981	67	71.6	(48)	17.9	(12)	10.4	(7)
1979	1979	333	82.0	(273)	10.2	(34)	7.8	(26)
	1980	634	88.6	(562)	7.3	(46)	4.1	(26)
	1981	170	55.9	(95)	22.3	(38)	21.8	(37)
1980	1980	305	81.6	(249)	10.2	(31)	8.2	(25)
	1981	213	68.5	(146)	22.5	(48)	8.9	(19)
1981b			-	-	-	-	-	-

[a]1978 release cruise--west coast of Vancouver Island and southern part of Queen Charlotte Sound.

[b]No release in 1981 off the west coast of Vancouver Island.

Table 7 (cont'd). Recoveries of sablefish at various distances from release areas in Queen Charlotte Sound for each year after release.

Tagging year	Recovery year	Total numbers recovered	% (no.) recoveries from release area		
			<50 km (no.)	50-200 km (no.)	>200 km (no.)
1980	1980	122	87.7 (107)	7.4 (9)	4.9 (6)
	1981	233	84.1 (196)	10.7 (25)	5.2 (12)

Table 7 (cont'd). Recoveries of sablefish at various distances from release areas in the inshore waters--inlets for each year after release.

Tagging year	Recovery year	Total numbers recovered	% (no.) recoveries from release area		
			<50 km (no.)	50-200 km (no.)	>200 km (no.)
1980	1980	472	98.5 (465)	1.1 (5)	0.4 (2)
	1981	272	68.0 (185)	8.1 (22)	23.9 (65)

Table 8. Recoveries of sablefish in relation to exact release area (west coast of the Queen Charlotte Islands in July 1977).

Exact release location (Fig. 13)	Total no. released	No. recovered			No. (%) recovered within 20 km of release location			Total no. and % recovered 1977-1981		
		1977-1979	1980	1981	1977-1979	1980	1981	No.	Total %	% ≤ 20 km
A	191	32	8	1	20 (63)	2 (25)	-	41	21.5	54.0
B	176	41	5	3	25 (61)	1 (20)	-	49	27.8	53.0
C	367	52	4	6	29 (56)	-	1 (17)	62	16.9	48.0
D	195	45	3	5	23 (51)	-	2 (40)	53	27.2	47.0
E	241	38	5	5	19 (50)	2 (40)	1 (20)	48	19.9	46.0
F	287	40	8	9	22 (55)	4 (50)	2 (22)	57	19.9	49.0
G	251	38	8	3	19 (50)	2 (25)	1 (33)	49	19.5	45.0
H	227	48	6	3	10 (21)	3 (50)	2 (67)	57	25.1	26.0
I	332	51	10	3	18 (35)	5 (50)	1 (33)	64	19.3	38.0
J	232	37	8	6	14 (38)	4 (50)	3 (50)	51	22.0	41.0
K	406	77	14	7	34 (44)	7 (50)	4 (57)	98	24.1	46.0
L	503	85	11	3	42 (49)	4 (46)	1 (33)	99	19.7	47.0
M	298	67	10	7	48 (72)	1 (10)	4 (57)	84	28.2	63.0
N	383	54	12	3	38 (70)	2 (17)	-	69	18.0	58.0
O	252	52	8	6	29 (56)	7 (88)	3 (50)	66	26.2	44.0
P	304	80	9	3	46 (56)	2 (22)	1 (33)	92	30.3	53.0
Q	294	65	7	8	39 (60)	5 (71)	3 (38)	80	27.2	59.0
R	230	79	2	4	41 (52)	2 (100)	1 (25)	85	40.0	52.0
Total	5,159	981	138	85	516 (53)	53 (38)	30 (35)	1,204	23.3	50.0

Table 9. Summary of distance and direction travelled by length interval for male and female sablefish tagged off the west coast of the Queen Charlotte Islands during 1977 and recaptured 1977-1981.

Release length (cm)	Sex		Distance from release area (km) and predominant direction														
			1977			1978			1979			1980			1981		
			<50	50-200	>200	<50	50-200	>200	<50	50-200	>200	<50	50-200	>200	<50	50-200	>200
<50	M&F	No. of fish	2[a]	-	-	4[a]	-	-	2[a]	-	-	-	-	-	-	-	-
		(direction)				1(S)											
>50	M&F	No. of fish	94[a]	5[a]	4(N)	445[a]	83[a]	14(N)	92[a]	25[a]	45(N)	54[a]	19[a]	16(N)	32[a]	16[a]	8(N)
		(direction)	20(S)	7(S)		36(S)	2(N)	11(S)	15(S)	1(N)	9(S)	9(S)	2(N)	14(S)	2(S)	9(S)	14(S)
							28(S)			31(S)			16(S)				
50-55	M	No. of fish	-	-	-	2[a]	-	-	1[a]	-	-	-	-	-	1[a]	-	-
		(direction)							1(S)								
56-60	M	No. of fish	6[a]	-	-	11[a]	1[a]	-	4[a]	1[a]	1(N)	1[a]	4[a]	-	2[a]	-	-
		(direction)							1(S)		1(S)						
>60	M	No. of fish	20[a]	1(S)	1(N)	89[a]	3[a]	1(N)	25[a]	3[a]	13(N)	26[a]	9[a]	7(N)	9[a]	1[a]	4(N)
		(direction)	3(S)			9(S)	2(N)		3(S)	4(S)		3(S)	5(S)	3(S)		3(S)	2(S)
							2(S)										
50-60	F	No. of fish	1[a]	-	-	2[a]	-	-	1[a]	-	2(N)	1[a]	-	1(N)	-	-	-
		(direction)												1(S)			
61-70	F	No. of fish	24[a]	2(S)	1(N)	51[a]	3[a]	1(N)	15[a]	3[a]	6(N)	4[a]	2[a]	4(N)	7[a]	1[a]	1(S)
		(direction)	4(S)			6(S)	3(S)	1(S)	1(S)	4(S)	1(S)		5(S)	3(S)		1(S)	
>70	F	No. of fish	33[a]	3[a]	-	119[a]	10[a]	3(S)	41[a]	12[a]	2(N)	19[a]	3[a]	1(N)	11[a]	13[a]	2(N)
		(direction)	13(S)	4(S)		17(S)	18(S)		7(S)	12(S)	2(S)	5(S)	2(N)	3(S)	1(S)	5(S)	5(S)
													3(S)				

[a]Same minor recovery as release area (NOTE: the release area of this cruise was in the southern part of Minor Area 31, and most recoveries from the same minor area were to the north).

Table 10. Summary of distance and direction travelled by length interval for male and female sablefish tagged off the west coast of the Queen Charlotte Islands during 1978 and recaptured 1978-1981.

Release length (cm)	Sex		Distance from release area (km) and predominant direction											
			1978			1979			1980			1981		
			<50	50-200	>200	<50	50-200	>200	<50	50-200	>200	<50	50-200	>200
<50	M&F	No. of fish	-	-	-	-	-	-	1[a]	-	-	-	-	-
>50	M&F	No. of fish	193[a]	3[a] 11(S) 1(N)	1(S)	106[a] 12(S)	17[a] 15(S) 4(N)	5(S) 14(N)	53[a] 1(S)	12[a] 10(S)	13(S) 9(N) 2(W)	27[a] 1(S)	11[a] 8(S)	4(S) 8(N)
50-55	M	No. of fish	-	-	-	-	-	-	-	-	2(S)	1[a]	-	-
56-60	M	No. of fish	11[a]	-	-	10[a]	2[a] 1(N)	-	8[a]	2(S)	1(S) 1(N)	3[a]	-	-
>60	M	No. of fish	37[a]	1(S) 1(N)	1(S)	26[a] 4(S)	3[a] 3(S)	3(N)	15[a]	4[a]	2(S) 1(N)	8[a] 1(S)	4[a] 2(S)	1(S) 2(N)
50-60	F	No. of fish	-	-	-	-	-	1(N)	1[a]	-	-	-	-	-
61-70	F	No. of fish	42[a]	5(S)	-	18[a] 1(S)	3[a] 4(S) 1(N)	1(S)	9[a]	1[a]	1(S) 2(N)	2[a]	1[a] 1(S)	1(S)
>70	F	No. of fish	43[a]	3[a] 3(S)	-	35[a] 7(S)	5[a] 5(S) 2(N)	2(S)	14[a] 1(S)	7[a] 7(S)	1(W) 4(S)	11[a]	6[a] 3(S)	1(S) 3(N)

[a]Fish recovered in same minor release area.

Table 11. Summary of distance and direction travelled by length interval for male and female sablefish tagged off the west coast of Vancouver Island during 1977 and recaptured 1977-1981.

Release length (cm)	Sex		Distance from release area (km) and predominant direction														
			1977			1978			1979			1980			1981		
			<50	50-200	>200	<50	50-200	>200	<50	50-200	>200	<50	50-200	>200	<50	50-200	>200
<50	M&F	No. of fish	-	-	-	2[a]	-	-	-	-	-	2[a]	-	1(N)	2[a]	-	-
>50	M&F	No. of fish	4(N)	2(N)	-	2[a]	2(S) 6(N)	1(N)	14[a] 6(S) 2(N)	3(S) 4(N)	1(S) 8(N)	40[a] 1(N) 4(S)	4(S) 4(N)	4(N)	14[a] 4(N)	1(S) 6(N)	5(N)
50-55	M	No. of fish	1(N)	-	-	1[a]	1[a]	-	-	-	2(N)	1[a]	1(N)	1(N)	4[a]	-	-
56-60	M	No. of fish	-	-	-	-	1(N)	-	3[a]	-	-	5[a]	-	-	2[a]	1(N)	-
>60	M	No. of fish	1[a]	-	-	-	-	-	1[a]	-	1(N)	1[a]	-	-	2[a] 1(N)	-	-
50-60	F	No. of fish	-	1(N)	-	1[a]	-	-	4[a]	1(S)	3(N)	11[a]	3(S)	-	-	1(N)	1(N)
61-70	F	No. of fish	2[a]	1(N)	-	-	-	1(N)	5[a]	1(N) 1(S)	1(S)	8[a] 2(S) 1(N)	1(N) 2(S)	-	2[a] 1(N)	2(N)	-
>70	F	No. of fish	-	-	-	1[a]	-	-	3[a]	1(N)	-	7[a]	-	-	2[a]	1(N)	-

[a]Fish recovered in same minor release area.

Table 12. Summary of distance and direction travelled by length interval of male and female sablefish tagged off the west coast of Vancouver Island during 1978 and recaptured 1978-1981.

Release length (cm)	Sex		Distance from release area (km) and predominant direction											
			1978			1979			1980			1981		
			<50	50-200	>200	<50	50-200	>200	<50	50-200	>200	<50	50-200	>200
<50	M&F	No. of fish	-	-	-	1[a]	-	-	-	-		-	-	-
>50	M&F	No. of fish	8[a] 2(N)	1[a] 1(N)	1(S) 1(N)	61[a] 2(S) 36(N)	3[a] 7(S) 6(N)	3(S) 11(N)	95[a] 17(S) 12(N)	1[a] 5(S) 6(N)	3(S) 9(N)	14[a] 5(N)	2[a] 7(S) 3(N)	1(S) 4(N)
50-55	M	No. of fish	1[a] 1(N)	-	-	-	-	-	3[a] 2(N)	-	-	-	-	-
56-60	M	No. of fish	1[a]	-	-	2[a] 1(N)	-	-	2[a] 1(S)	-	1(S)	2[a] 1(N)	-	-
>60	M	No. of fish	-	-	1(S)	13[a] 7(N)	1[a] 1(N)	1(N)	15[a] 4(S)	2(S)	-	1[a] 2(N)	2(S) 2(N)	-
50-60	F	No. of fish	1[a]	-	1(N)	-	-	2(N)	2[a] 1(N)	1(S)	-	-	-	-
61-70	F	No. of fish	2[a]	-	-	14[a] 2(N)	1[a] 2(S) 2(N)	-	27[a] 3(S) 1(N)	1[a] 1(N)	1(S) 1(N)	1[a]	3(S)	2(N)
>70	F	No. of fish	2[a]	1[a] 1(N)	-	28[a] 1(S) 3(N)	1[a] 1(S) 2(N)	3(N)	40[a] 9(S) 6(N)	3(N)	1(N)	8[a] 2(N)	1[a] 2(S) 1(N)	1(N)

[a]Fish recovered in same minor release area.

Table 13. Summary of distance and direction travelled for male and female juvenile sablefish tagged inshore during 1979 and recaptured 1979-81.

Release length (cm)	Sex		Distance from release area (km) and predominant direction								
			1979			1980			1981		
			<50	50-200	>200	<50	50-200	>200	<50	50-200	>200
≤50	M&F	No. of fish	15[a]	-	-	33[a] 39(S)	26(N) 8(S)	2[a] 12(N)	5[a] 1(N)	6[a] 6(S) 2(W)	7(S) 26(N)
>50	M&F	No. of fish	1[a]	-	-	3[a]	1(S)	2(N)	-	1[a]	3(S) 4(N)
≤50	M	No. of fish	3[a]	-	-	15[a] 2(N)	5[a] 10(N) 3(S)	1[a] 5(N)	3[a]	2[a] 2(N) 2(S)	9(N)
>50	M	No. of fish	-	-	-	-	-	1(N)	-	-	1(N)
≤50	F	No. of fish	3[a]	-	-	29[a] 1(S)	6[a] 14(N) 4(S)	1[a] 2(N)	1[a] 1(N)	3(S) 3(W)	12(N)
>50	F	No. of fish	1[a]	-	-	3[a]	1(S)	1(N)	-	1[a]	3(N) 2(S)

[a]Fish recovered in same minor release area.

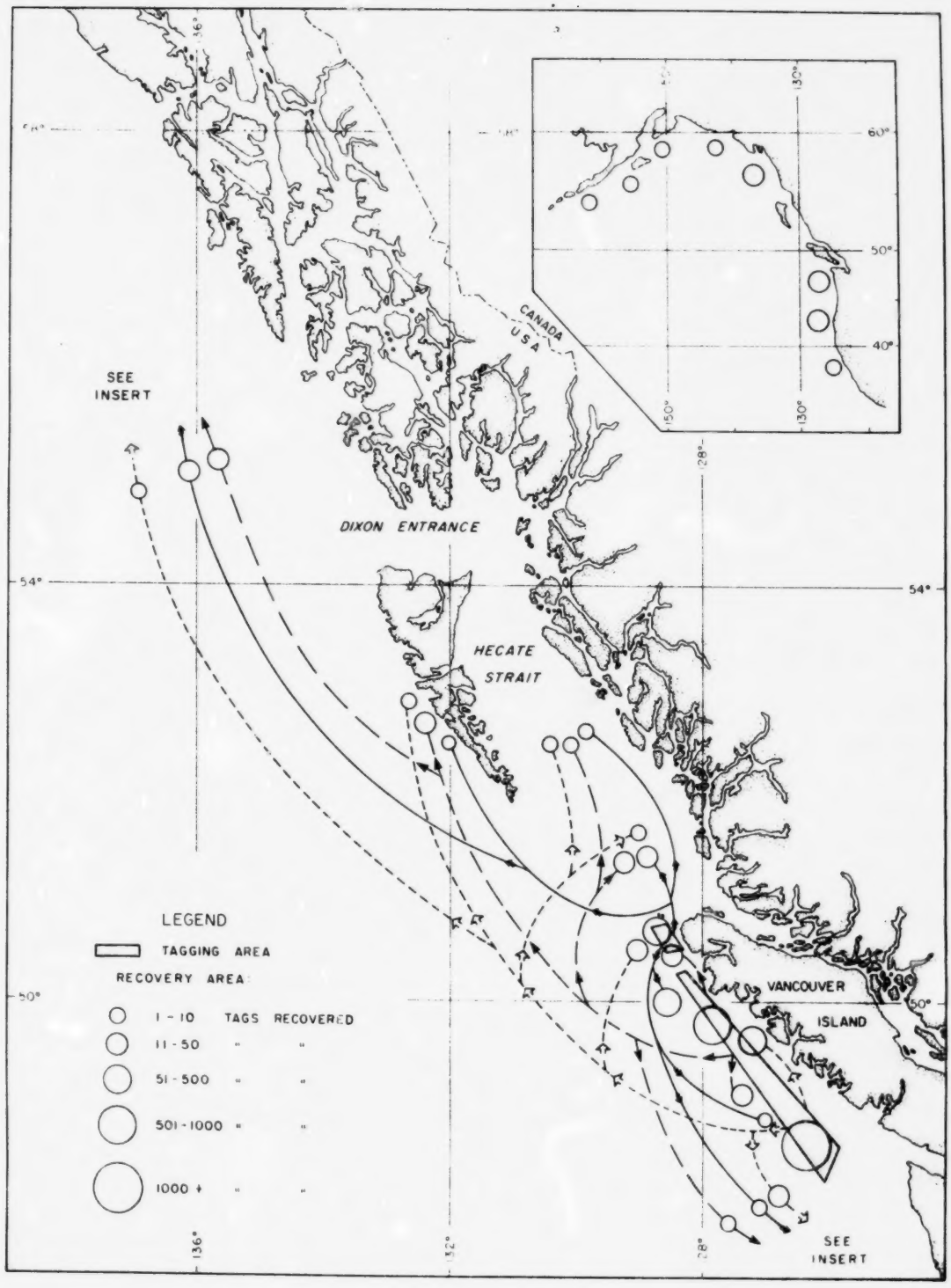


Fig. 13. Recoveries of sablefish as of December 1981 of fish released off the west coast of Vancouver Island from 1977-1980. Insert shows tags recovered in USA waters.

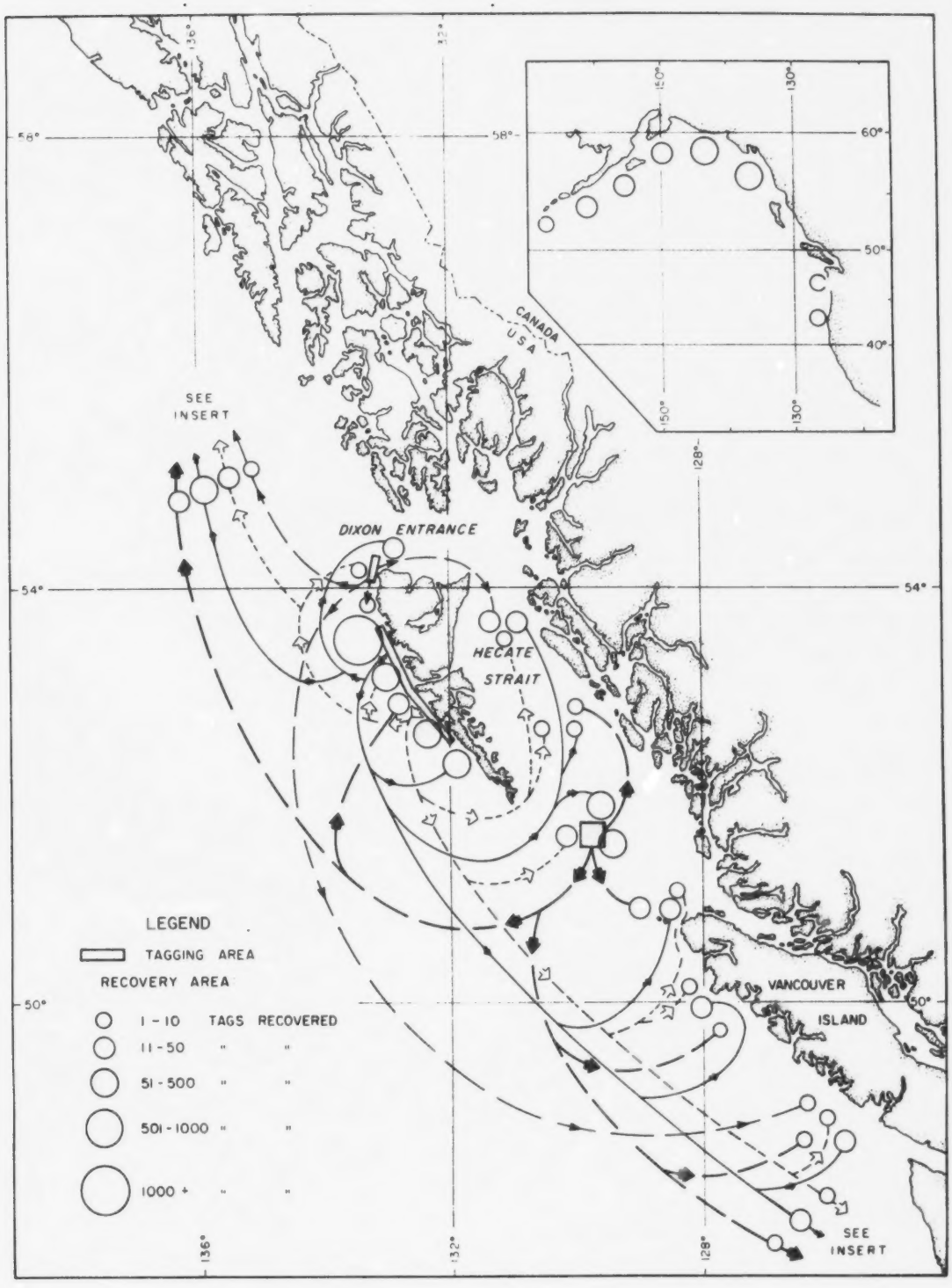


Fig. 14. Recoveries of sablefish as of December 1981 of fish released off the west coast of the Queen Charlotte Islands and Queen Charlotte Sound from 1977-1981. Insert shows fish recovered in USA waters.

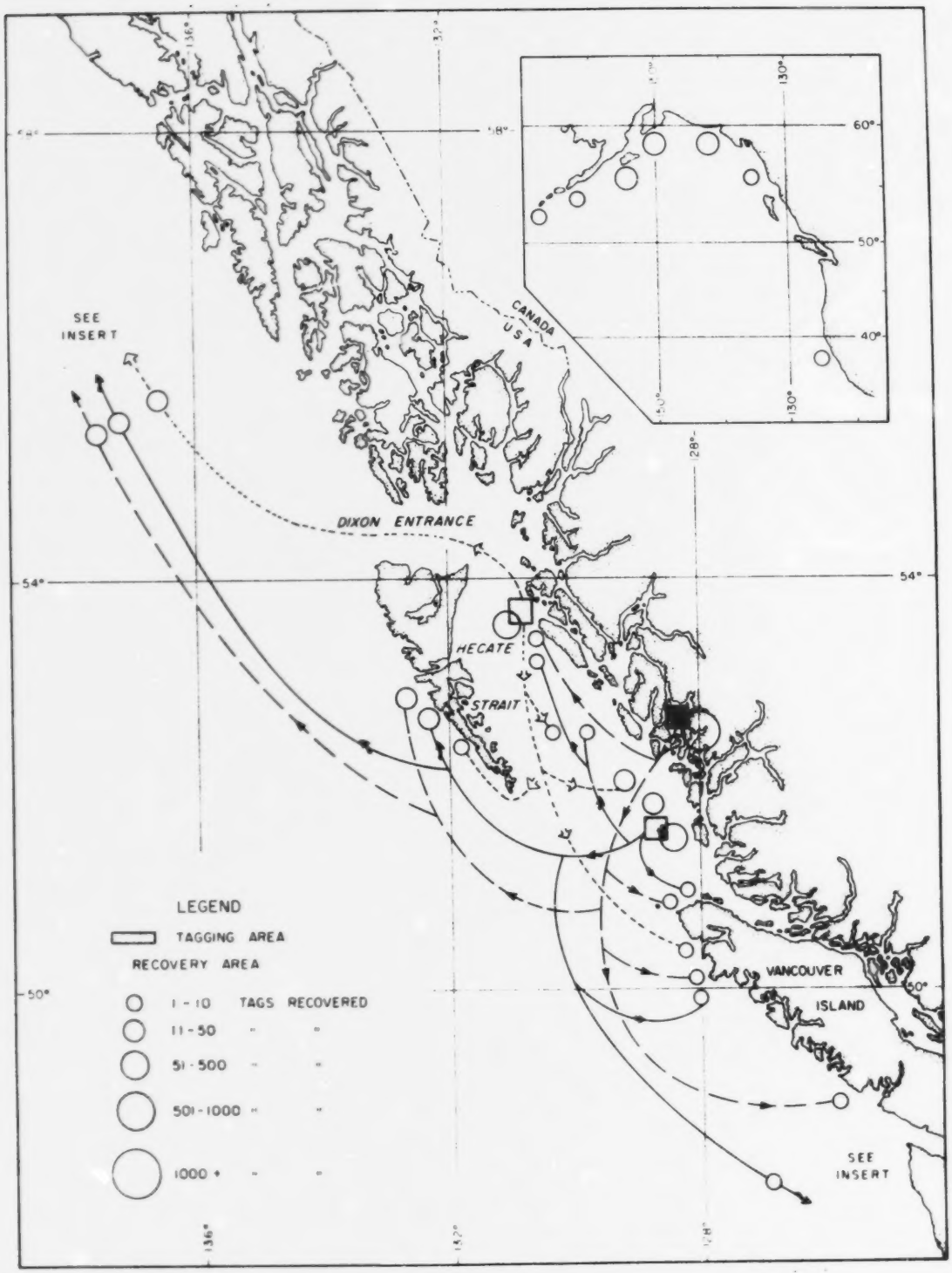


Fig.15. Recoveries of sablefish as of December 1981 of juvenile fish released in Queen Charlotte Sound, Hecate Strait and the coastal inlets in 1979-1981. Insert shows fish recovered in USA waters.

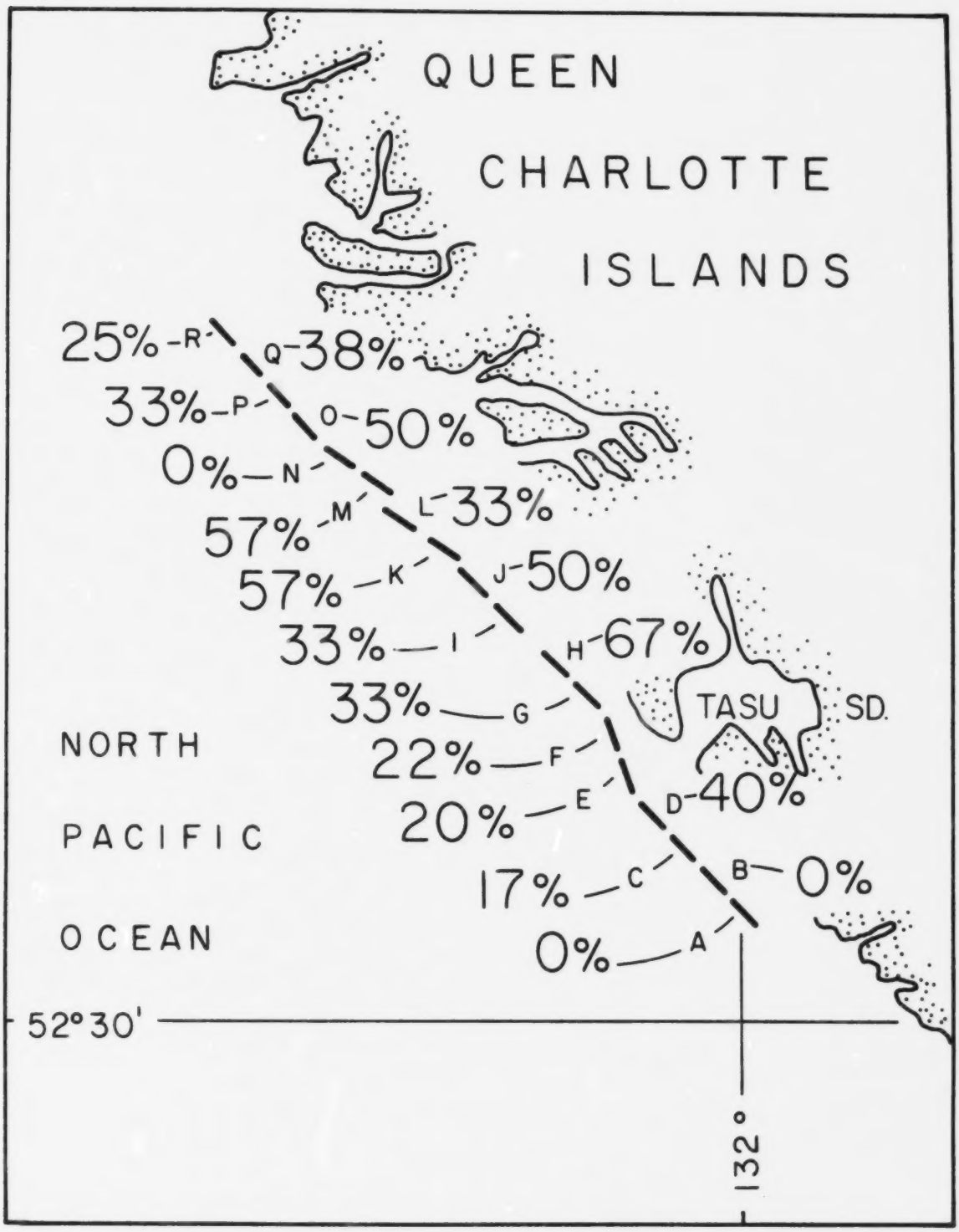


Fig. 16. Per cent of 1981 tag recoveries made within 20 km of the original release area. Release areas began at bottom right and are labelled A to R (See Table 9).

than south is real, however it is important to remember that it is only a small number of fish that migrate further than 200 km and about two-thirds of these move north while one-third moves south. The total number of adults that moved more than 200 km and north represents only 6.7% of all recoveries.

Different exploitation rates in the Canadian and United States zones could influence the interpretation of directional movements. In addition, there appears to be significant under-reporting of recovered fish in the United States zone which would increase the percentage of fish moving out of the Canadian zone. Because only 5.5% of all adult recoveries have been made in the United States zone we do not feel that correcting for catch and non-reporting will alter the conclusion that most fish tagged in the Canadian zone have remained in the Canadian zone.

Because the number of recoveries may be highest in the period immediately after release, a comparison using total recoveries may bias the significance of longer-term recoveries. If the number of fish recovered at distances greater than 200 km is compared with total recoveries in the third, fourth, and fifth years of liberty for releases in 1977 and 1978 off the west coast of the Queen Charlotte Islands (Table 14) there is an almost constant percentage (20-27%) of fish that migrate more than 200 km each year (Table 14). The percentage of these fish found in the United States zone is lower and more variable and does not show a major trend towards increasing or decreasing recoveries.

For releases in 1977 and 1978 off the west coast of Vancouver Island (Table 14) the percent recoveries of fish that moved more than 200 km varies from 6 to 24% with approximately one-third of these recoveries made in the U.S. zone.

If only recoveries in the 3rd, 4th, and 5th years are considered, the percentage of fish recovered annually in the United States zone increases from 5.5% for 1977 and 1978 releases (Table 14) to approximately 10%. Thus most recoveries (approx. 75%) are still made close to the release area and a relatively small percentage move into the United States zone.

As mentioned, the percentage movement into the U.S. zone will change if corrections are made for non-reporting of recaptures and increased effort in the U.S. zone. It is difficult to make these corrections at this time because reliable estimates of non-reporting have not been made. However, even if the percent movement into the U.S. zone were doubled, 80% of all recoveries would still be made in the Canadian zone each year.

In contrast to the direction of movements for fish that migrated more than 200 km, fish that moved less than 200 km and crossed a minor area boundary exhibited a strong tendency to move southward. Of the fish tagged in 1977 and 1978 off the west coast of the Queen Charlotte Islands, 232 fish moved south and 10 north. Of fish tagged in 1977 and 1978 off Vancouver Island, 105 moved north and 58 moved south. The apparent migration south from the Queen Charlotte Islands and north from Vancouver Island may result in part from increasing catches in Queen Charlotte Sound. In 1977 only 17 t were landed from Queen Charlotte Sound compared to 1360 t in 1981. However, despite this increase in catch there does appear to be a trend for some fish to move into the Queen Charlotte Sound area.

Table 14. Recoveries of all tagged adult sablefish >200 km and those in the U.S. zone for the 3rd, 4th, and 5th years of liberty. Brackets indicate % of total recaptures.

Area	Release	Recovery					
		1979		1980		1981	
		>200 km	U.S.	>200 km	U.S.	>200 km	U.S.
Queen Charlotte Islands	1977	54 (24%)	44 (20%)	32 (24%)	20 (15%)	22 (27%)	8 (10%)
	1978	-	-	24 (24%)	11 (11%)	12 (21%)	8 (14%)
Vancouver Island	1977	9 (24%)	6 (16%)	4 (6%)	0 (0%)	5 (15%)	1 (3%)
	1978	-	-	12 (9%)	8 (5%)	5 (14%)	0 (0%0

Recoveries of sablefish by month (Table 15) show no trends. The observed fluctuations can be explained by changes in fishing effort and commercial regulations. Similarly we have been unable to detect trends in movement of fish specifically related to sex or size (Tables 9, 10, 11, 12, 13).

The conclusion that there is an increasing percentage of fish that move out of the release area will not be changed by adjusting recoveries for fluctuations in catch. Despite this increase in the number of fish that move out of the release area, most recoveries are from the release area. There is movement into United States waters by a small percentage of fish tagged in the Canadian zone. There is a minor trend for a small number of fish that move more than 200 km to move north and there was an indication that juveniles that move out of the Canadian zone, move north.

The observed movement into the U.S. zone of 5.5% of all recoveries or approximately 10% of fish that have been at liberty for 3 years or longer and the extensive movements of a few sablefish, indicate that there is interbreeding throughout their range. Hence sablefish can be considered to be one population. But a large number of fish are recovered in the vicinity of the release area. Since movement out of any area is relatively slow and sablefish are heavily exploited, it appears that distinct stocks exist. However, more information is needed about the recruitment process before management strategies for these stocks can be developed.

TAG LOSS

In the experiments where double tagging was conducted, 9.1% of the fish received a second tag (Table 2). The recovery percentage of double-tagged fish (8.1%, Table 5) is very similar to the percent of double-tagged fish released indicating no increased mortality resulted from applying two tags. There was an overall loss of one tag from 12.6% of the double-tagged fish (Table 16) with the suture tag being lost from 5.3% and the anchor tag from 7.3%. There is no obvious trend to the loss so it is not possible to conclude that one type of tag is more suitable.

It is not possible to determine when loss occurs. However, recoveries of fish with lost tags have occurred each year with no increasing trend (Table 16).

It is apparent from the double-tag studies that tag loss is important. While it is possible that the loss of one of the two tags is not indicative of the loss when a fish receives only one tag, it is more probable that the results are representative of actual tag loss.

Based on a previous study (White and Beamish 1972) it was expected that the suture tag would not be lost if properly applied. The suture tag was lost, possibly because of the technical difficulty of applying the tag. Because 7.3% of the fish were returned with only suture tags, the anchor tag loss is at least 7.3%. The loss of 5.3% of the suture tags cannot be added to the tag loss for anchor tags but probably indicates that loss of one tag is higher than 7.3%.

Table 15. Monthly recoveries of sablefish at various distances from release areas for each tagging cruise, 1977-1980∞.

Distance from release area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
						1977						
						Queen Charlotte Islands - July 1977						
<50	-	-	-	-	-	-	-	65	35	16	0	0
50-200 km	-	-	-	-	-	-	-	2	3	7	0	0
>200 km	-	-	-	-	-	-	-	0	2	1	1	0
Total	-	-	-	-	-	-	-	67	40	24	1	0
						Vancouver Island - September 1977						
<50 km	-	-	-	-	-	-	-	-	-	-	1	3
50-200 km	-	-	-	-	-	-	-	-	-	-	1	1
>200 km	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	-	-	2	4
						1978						
						Queen Charlotte Island - July 1977						
<50 km	-	-	0	5	83	105	0	97	60	66	66	4
50-200 km	-	-	1	-	47	14	2	14	7	6	22	0
>200 km	-	-	0	7	6	4	0	3	2	2	0	1
Total	-	-	1	12	136	123	2	114	69	74	88	5
						Vancouver Island - September 1977						
<50 km	1	0	0	0	1	0	0	0	2	0	0	0
50-200 km	1	0	0	0	5	0	0	1	1	0	0	0
>200 km	0	0	0	0	0	0	0	0	0	0	0	1
Total	2	0	0	0	6	0	0	1	3	0	0	1
						Queen Charlotte Islands - May 1977						
<50 km	-	-	-	-	-	6	0	50	55	43	37	2
50-200 km	-	-	-	-	-	0	0	7	4	1	3	0
>200 km	-	-	-	-	-	0	0	0	1	0	0	0
Total	-	-	-	-	-	6	0	57	60	44	40	2
						Queen Charlotte Islands - June 1978						
<50 km	-	-	-	-	-	1	0	0	5	3	7	2
50-200 km	-	-	-	-	-	0	0	0	0	1	1	0
>200 km	-	-	-	-	-	0	0	0	1	0	1	0
Total	-	-	-	-	-	1	0	0	6	4	9	2

Table 15 (cont'd)

Distance from release area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
						1978 (cont'd)						
						Queen Charlotte Islands - October 1978						
<50 km	-	-	-	-	-	-	-	-	-	0	0	0
50-200 km	-	-	-	-	-	-	-	-	-	0	0	0
>200 km	-	-	-	-	-	-	-	-	-	0	0	0
Total	-	-	-	-	-	-	-	-	-	0	0	0
						1979						
						Queen Charlotte Islands - July 1977						
<50 km	22	8	15	17	7	25	9	0	1	5	1	0
50-200 km	1	2	2	4	3	7	7	7	8	4	10	2
>200 km	2	0	2	3	5	14	8	6	7	6	1	0
Total	25	10	19	24	15	46	24	13	16	15	12	2
						Vancouver Island - September 1977						
<50 km	0	0	0	0	3	2	0	6	8	0	2	1
50-200 km	1	0	0	0	0	2	0	0	1	0	2	1
>200 km	0	0	1	0	1	1	3	1	1	1	0	0
Total	1	0	1	0	4	5	3	7	10	1	4	2
						Queen Charlotte Islands - May 1978						
<50 km	20	7	9	6	9	16	22	2	5	3	3	7
50-200 km	0	0	4	3	2	4	6	8	3	1	2	0
>200 km	2	0	0	0	4	4	4	1	0	3	1	0
Total	22	7	13	9	15	24	32	11	8	7	6	7
						Queen Charlotte Sound-Vancouver Island - June 1978						
<50 km	0	0	3	0	51	5	9	25	2	0	6	0
50-200 km	4	0	1	0	0	11	1	1	1	0	1	0
>200 km	3	0	0	0	2	3	6	4	3	1	0	0
Total	7	0	4	0	53	19	16	30	6	1	7	0
						Queen Charlotte Islands - October 1978						
<50 km	-	-	1	6	0	1	0	2	0	1	0	0
50-200 km	-	-	1	0	0	0	1	0	1	0	0	0
>200 km	-	-	0	0	1	0	0	0	0	0	0	0
Total	-	-	2	6	1	1	1	2	1	1	0	0

Table 15 (cont'd)

Distance from release area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
						1979						
						Vancouver Island - May 1979						
<50 km	-	-	-	-	-	10	13	89	60	29	24	48
50-200 km	-	-	-	-	-	7	2	3	7	1	14	0
>200 km	-	-	-	-	-	5	13	2	1	2	2	1
Total	-	-	-	-	-	22	28	94	68	32	40	49
						Queen Charlotte Islands - June 1979						
<50 km	-	-	-	-	-	6	206	91	25	7	30	17
50-200 km	-	-	-	-	-	0	8	13	13	7	20	1
>200 km	-	-	-	-	-	1	1	8	8	4	3	2
Total	-	-	-	-	-	7	215	112	46	18	53	20
						Queen Charlotte Islands - August 1979						
<50 km	-	-	-	-	-	-	-	-	-	1	-	-
50-200 km	-	-	-	-	-	-	-	-	-	0	-	-
>200 km	-	-	-	-	-	-	-	-	-	0	-	-
Total	-	-	-	-	-	-	-	-	-	1	-	-
						1980						
						Queen Charlotte Islands - July 1977						
<50 km	0	5	1	10	3	12	8	11	8	6	0	0
50-200 km	1	4	0	4	3	3	3	15	3	1	0	0
>200 km	1	0	0	4	11	6	0	5	4	3	1	0
Total	2	9	1	18	17	21	11	31	15	10	1	0
						Vancouver Island - September 1977						
<50 km	4	3	0	9	0	3	7	16	1	0	6	0
50-200 km	4	1	0	2	1	0	0	0	0	0	0	0
>200 km	0	0	0	1	0	2	0	0	2	0	0	0
Total	8	4	0	12	1	5	7	16	3	0	6	0
						Queen Charlotte Islands - May 1978						
<50 km	0	8	0	5	4	12	1	17	5	2	0	0
50-200 km	0	2	0	0	2	2	3	11	1	0	0	0
>200 km	0	0	3	3	4	1	3	3	3	0	3	0
Total	0	10	3	8	10	15	7	31	9	2	3	0

Table 15 (cont'd)

Distance from release area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
						1980 (cont'd)						
						Queen Charlotte Sound-Vancouver Island - June 1978						
<50 km	-	-	16	25	26	34	20	1	7	6	5	0
50-200 km	-	-	1	1	4	2	1	2	0	2	0	0
>200 km	-	-	0	1	2	1	3	5	0	4	0	0
Total	-	-	17	27	32	37	24	8	7	12	5	0
						Queen Charlotte Islands - October 1978						
<50 km	-	-	-	-	0	0	1	-	-	-	-	-
50-200 km	-	-	-	-	0	1	0	-	-	-	-	-
>200 km	-	-	-	-	1	0	0	-	-	-	-	-
Total	-	-	-	-	1	1	1	-	-	-	-	-
						Vancouver Island - May 1979						
<50 km	18	6	1	245	70	143	3	20	5	33	18	0
50-200 km	3	2	0	3	1	3	5	21	2	2	4	0
>200 km	1	2	5	1	3	2	3	5	0	3	1	0
Total	22	10	6	249	74	148	11	46	7	38	23	0
						Queen Charlotte Islands - June 1979						
<50 km	1	17	0	30	33	120	18	61	15	25	0	-
50-200 km	1	14	0	9	6	8	17	34	9	3	0	-
>200 km	0	1	0	8	9	13	12	14	13	5	6	-
Total	2	32	0	47	48	141	47	109	37	33	6	-
						Queen Charlotte Islands - August 1979						
<50 km	0	1	0	1	0	0	2	2	1	0	-	-
50-200 km	1	0	0	0	0	0	0	0	0	0	-	-
>200 km	0	0	0	0	0	1	0	0	0	1	-	-
Total	1	1	0	1	0	1	2	2	1	1	-	-
						Queen Charlotte Islands - February 1980						
<50 km	-	0	0	3	1	2	18	5	2	0	0	-
50-200 km	-	2	0	3	2	3	3	6	1	3	0	-
>200 km	-	0	0	1	2	2	0	5	0	4	1	-
Total	-	2	0	7	5	7	21	16	3	7	1	-

Table 15 (cont'd)

Distance from release area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
					1980 (cont'd)							
					Vancouver Island - March 1980							
<50 km	-	-	-	34	102	63	15	6	5	22	2	-
50-200 km	-	-	-	1	2	5	2	3	10	2	6	-
>200 km	-	-	-	3	2	3	2	6	4	4	1	-
Total	-	-	-	38	106	71	19	13	19	28	9	-
					Queen Charlotte Sound - March 1980							
<50 km	-	-	-	4	15	25	38	1	11	1	12	-
50-200 km	-	-	-	1	2	2	2	1	0	1	0	-
>200 km	-	-	-	0	0	0	0	0	1	4	1	-
Total	-	-	-	5	17	27	40	2	12	6	13	-
					Inlets - May 1980							
<50 km	-	-	-	-	-	-	-	13	138	27	287	-
50-200 km	-	-	-	-	-	-	-	0	1	4	0	-
>200 km	-	-	-	-	-	-	-	1	0	1	0	-
Total	-	-	-	-	-	-	-	14	139	32	287	-
					Queen Charlotte Islands - July 1980							
<50 km	-	-	-	-	-	-	3	8	4	5	-	-
50-200 km	-	-	-	-	-	-	0	1	2	0	-	-
>200 km	-	-	-	-	-	-	0	0	0	0	-	-
Total	-	-	-	-	-	-	3	9	6	5	-	-
					Strait of Georgia - February 1980							
<50 km	-	-	-	-	0	-	-	-	-	-	-	-
50-200 km	-	-	-	-	1	-	-	-	-	-	-	-
>200 km	-	-	-	-	0	-	-	-	-	-	-	-
Total	-	-	-	-	1	-	-	-	-	-	-	-
					1981							
					Queen Charlotte Islands - July 1977							
<50 km	-	0	1	5	5	5	7	3	3	2	3	0
50-200 km	-	4	11	4	0	1	2	2	1	0	0	0
>200 km	-	0	4	5	4	3	0	2	5	0	0	0
Total	-	4	16	14	9	9	9	7	9	2	3	0

Table 15 (cont'd)

Distance from release area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
					1981 (cont'd)							
					Vancouver Island - September 1977							
<50 km	-	1	1	1	12	0	0	2	4	0	0	0
50-200 km	-	2	1	0	2	0	0	1	1	0	0	0
>200 km	-	2	0	1	0	2	0	0	0	0	0	0
Total	-	5	2	2	14	2	0	3	5	0	0	0
					Queen Charlotte Islands - May 1978							
<50 km	-	1	6	3	2	4	5	3	2	1	0	0
50-200 km	-	4	6	0	4	1	1	1	1	0	0	0
>200 km	-	0	2	2	1	1	0	1	2	2	0	0
Total	-	5	14	5	7	6	6	5	5	3	0	0
					Queen Charlotte Sound-Vancouver Island - June 1978							
<50 km	-	2	2	8	8	3	9	5	8	3	0	0
50-200 km	-	1	1	2	1	4	2	0	1	0	0	0
>200 km	-	0	1	1	2	0	0	3	0	0	0	0
Total	-	3	4	11	11	7	11	8	9	3	0	0
					Queen Charlotte Islands - October 1978							
<50 km	-	0	0	0	0	0	0	0	1	0	0	0
50-200 km	-	0	1	0	0	0	0	0	0	0	0	0
<200 km	-	0	0	0	1	0	0	0	0	0	0	0
Total	-	0	1	0	1	0	0	0	1	0	0	0
					Vancouver Island - May 1979							
<50 km	0	0	27	17	36	1	1	2	11	0	0	0
50-200 km	0	8	3	2	12	3	2	5	3	0	0	0
>200 km	1	1	2	4	4	6	2	7	8	1	0	0
Total	1	9	32	23	52	10	5	14	22	1	0	0
					Queen Charlotte Islands - June 1979							
<50 km	-	42	54	15	34	22	19	19	20	1	2	0
50-200 km	-	1	17	2	5	2	2	6	2	1	0	0
>200 km	-	2	5	8	12	9	3	2	5	3	0	1
Total	-	45	76	25	51	33	24	27	27	5	2	1

Table 15 (cont'd)

Distance from release area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
					1981 (cont'd)							
					Queen Charlotte Islands - August 1979							
<50 km	-	-	-	1	0	0	3	0	1	0	-	-
50-200 km	-	-	-	0	0	0	0	0	1	1	-	-
>200 km	-	-	-	0	0	0	1	0	0	0	-	-
Total	-	-	-	1	0	0	4	0	2	1	-	-
					Queen Charlotte Islands - February 1980							
<50 km	-	0	5	1	0	4	5	1	8	0	0	0
50-200 km	-	8	10	4	3	3	0	1	3	0	0	2
>200 km	-	1	0	2	3	1	2	1	3	0	2	0
Total	-	9	15	7	6	8	7	3	14	0	2	2
					Vancouver Island - March 1980							
<50 km	-	16	8	26	23	10	19	0	32	3	0	0
50-200 km	-	0	4	15	4	9	7	3	4	0	0	2
>200 km	-	2	3	1	5	1	2	3	1	1	0	0
Total	-	18	15	42	32	20	28	6	37	4	0	2
					Queen Charlotte Sound - March 1980							
<50 km	-	21	18	32	36	19	29	25	11	0	1	0
50-200 km	-	4	5	6	3	3	1	0	1	1	0	4
>200 km	-	0	2	1	3	3	0	0	2	1	0	0
Total	-	25	25	39	42	25	30	25	14	2	1	4
					Inlets -May 1980							
<50 km	0	0	1	77	61	0	0	1	45	0	0	0
50-200 km	0	2	0	2	4	3	7	1	1	0	0	2
<200 km	2	9	11	7	13	5	1	6	5	2	3	1
Total	2	11	12	86	78	8	8	8	51	2	3	3
					Queen Charlotte Islands - July 1980							
<50 km	-	3	6	2	9	15	8	13	4	0	1	-
50-200 km	-	2	4	1	0	1	3	0	1	0	0	-
>200 km	-	1	2	3	3	2	3	1	0	0	1	-
Total	-	6	12	6	12	18	14	14	5	0	2	-

Table 15 (cont'd)

Distance from release area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
	1981 (cont'd) Strait of Georgia - February 1980											
<50 km	-	-	-	-	-	-	-	-	-	-	-	-
20-500 km	-	-	-	-	-	-	-	-	-	-	-	-
>200 km	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	-	-	-	-
	Queen Charlotte Islands - March 1981											
<50 km	-	-	3	4	5	12	15	15	6	1	3	0
50-200 km	-	-	5	1	5	7	6	2	0	0	1	0
>200 km	-	-	0	0	2	6	0	4	7	6	2	4
Total	-	-	8	5	12	25	21	21	13	7	6	4
	Queen Charlotte Islands - June 1981											
<50 km	-	-	-	-	-	2	17	11	42	13	3	0
50-200 km	-	-	-	-	-	1	1	4	3	3	2	0
>200 km	-	-	-	-	-	0	1	2	1	0	0	1
Total	-	-	-	-	-	3	19	17	46	16	5	1

-Fish of unknown recapture location are not included.

Table 16. Double-tagged fish, cumulative tag recoveries for 1977-81.

Release year		Recovery year after tagging 0	1	2	3	4	Total (%)
1977 (n=1026)	anchor only	-	-	-	1	2	3 (2.1)
	suture only	2	3	-	1	-	6 (4.3)
	both tags	11	64	30	18	9	132 (93.6)
	total	13	67	30	20	11	141
1978 (n=1054)	anchor only	-	2	4	-		6 (8.3)
	suture only	-	1	-	1		2 (2.8)
	both tags	8	24	23	9		64 (88.9)
	total	8	27	27	10		72
1979 (n=1386)	anchor only	3	4	7			14 (5.3)
	suture only	7	9	9			25 (9.4)
	both tags	92	93	41			226 (85.3)
	total	102	106	57			265
1980 (n=1610)	anchor only	6	4				10 (7.1)
	suture only	4	8				12 (8.6)
	both tags	60	58				118 (84.3)
	total	70	70				140
Total		193	270	114	30	11	618

Because the suture tag is difficult and time-consuming to apply and the results to date do not indicate that our application of the suture tag results in a more permanent tag it may be easier to apply two anchor tags. Certainly an assessment of tag loss should always be made.

OXYTETRACYCLINE DOSAGE EXPERIMENTS

Of the 5279 fish tagged off the west coast of Vancouver Island in 1977 and injected with 100 mg/kg otc, 160 or 3% were recovered as of December 31, 1981 (Table 17). In June 1978, off Vancouver Island and in Queen Charlotte Sound, 5463 fish were tagged and injected with OTC. As of December 31, 1981, 418 or 7.7% have been recovered (Table 17). In May 1978, 5284 fish were tagged and released off the Queen Charlotte Islands. Of these, 866 were not injected. Two hundred and forty or 5.4% of the injected fish have been recovered compared to 292 or 33.7% of the uninjected fish (Table 17).

While the recovery rate for fish injected with 100 mg/kg OTC is low when compared with uninjected fish in this tagging program it is high compared to recovery rates of the other studies mentioned earlier (Sasaki 1979, Edson 1954, Phillips 1969). Thus, in order to assess the degree of mortality involved, dosage rate studies were initiated during 1981. Of the 1477 fish tagged and receiving no injection during March and June, 62 or 4.2% were recovered during the remainder of 1981 (Table 18). Of 1481 fish tagged and injected with a full dose (100 mg/kg) of OTC only 11 or 0.7% were recovered. Of the 1472 fish tagged and injected with the same volume of OTC diluted with 1% saline, 68 or 4.6% were recovered. Eighty or 5.4% of the 1484 fish receiving the same volume of 1% saline and no OTC, were recovered. As all fish were released in the same area and were subjected to the same fishing pressure the difference in recovery percentages is real and significant (t-test, $P<0.05$). These results indicate that the concentration of OTC and not the volume of fluid injected is contributing to the increased mortality in the injected fish.

The results of the laboratory experiment to examine the effect of an OTC dosage of 100 mg/kg and 25 mg/kg on mortality and growth of juveniles (Beamish et al. 1980) was completed in 1981 (Table 19). As reported earlier there was no immediate mortality associated with either treatment and while some mortalities have occurred there is no significant difference among treatments. Differences in growth were examined by testing the coincidence of regression lines, and no significant differences were found ($P>0.05$). Thus in the laboratory the range of doses does not affect growth or mortality while in the natural environment there is a definite increase in mortality. The reason for this difference in response is unknown at this time.

AGE VALIDATION STUDIES

A total of 154 pairs of otoliths were recovered in 1980 and 1981 from fish injected with oxytetracycline in 1977 and 1978. One hundred and

Table 17. Summary of recoveries until December 31, 1981, of fish released in OTC experiments, 1977-1978.

Cruise	Number injected[a]	Number recovered	% recovered	Number uninjected	Number recovered	% recovered
September 1977	5,279	160	3.0	226	1	0.4
May 1978[b]	4,418	240	5.4	866	292	33.7
June 1978	5,463	418	7.7	2	0	-
Total	15,014	818	5.4	1,067	293	27.5

[a]Injected with 100 mg OCT/kg
[b]Includes 1977 releases recaptured in May 1978.

Table 18. Summary of recoveries until December 31, 1981 of fish released in OTC experiments in March and June, 1981.

Dosage	Cruise	Number released	Number recovered	% recovered
No injection	March	749	35	4.7
	June	728	27	3.7
	Total	1,477	62	4.2
100 mg OTC/kg	March	747	6	0.8
	June	734	5	0.7
	Total	1,481	11	0.7
25 mg OTC/kg (made to volume with 1% saline solution)	March	750	35	4.7
	June	722	33	4.6
	Total	1,472	68	4.6
1% saline solution	March	760	41	5.4
	June	724	39	5.4
	Total	1,484	80	5.4
Total		5,914	221	3.7

Table 19. Summary of growth of sablefish held in captivity (juveniles).

Date in tank	Dose of OTC	Dec/79 Mean length (cm)	Dec/79 S.D.	Dec/79 n	April/80 Mean length (cm)	April/80 S.D.	April/80 n	July/80[a] Mean length (cm)	July/80[a] S.D.	July/80[a] n	Oct/80 Mean length (cm)	Oct/80 S.D.	Oct/80 n	Jan/81[a] Mean length (cm)	Jan/81[a] S.D.	Jan/81[a] n
Dec 13/79	none	52.80	2.15	20	57.97	2.25	19	61.65	2.27	19	64.92	2.88	17	66.68	3.72	17
	none	48.83	2.43	20	57.78	2.48	19	61.77	2.97	18	64.90	3.52	17	66.92	3.78	17
	25 mg/kg	49.49	1.92	20	57.92	2.45	19	61.03	3.05	19	63.84	3.34	19	65.59	3.41	19
	100 mg/kg	48.23	2.88	20	55.71	3.64	20	58.45	3.73	19	61.24	4.63	19	62.62	5.22	19

Date in tank	Dose of OTC	May/81[a] Mean length (cm)	May/81[a] S.D.	May/81[a] n	Sept/81 Mean length (cm)	Sept/81 S.D.	Sept/81 n	Jan/82[a] Mean length (cm)	Jan/82[a] S.D.	Jan/82[a] n	May/82[a] Mean length (cm)	May/82[a] S.D.	May/82[a] n
Dec 13/79	none	69.05	4.00	15	70.56	4.76	15	72.13	5.42	13	72.14	4.50	8
	none	68.58	4.06	17	70.06	4.34	16	71.20	4.49	16	72.36	4.96	14
	25 mg/kg	67.11	3.64	20	68.16	3.99	20	69.21	4.45	19	69.46	4.71	17
	100 mg/kg	64.19	5.80	16	64.50	5.98	16	65.08	6.58	14	65.48	6.86	13

[a]Used to calculate mean growth.

Mean growth (cm) of sablefish held in captivity, injected with varying doses of OTC (since Dec. 13/79).

Dose	.5 years $\bar{x}$ growth	.5 years S.D.	.5 years n	1.0 years $\bar{x}$ growth	1.0 years S.D.	1.0 years n	1.5 years $\bar{x}$ growth	1.5 years S.D.	1.5 years n	2.0 years $\bar{x}$ growth	2.0 years S.D.	2.0 years n	2.5 years $\bar{x}$ growth	2.5 years S.D.	2.5 years n
none	12.33	1.36	19	17.02	2.89	17	19.13	3.34	15	22.44	4.77	13	22.80	4.39	8
none	13.29	1.81	18	18.44	2.80	17	20.09	2.96	17	22.76	3.33	16	23.65	3.61	14
25 mg/kg	11.51	2.38	19	16.22	2.91	19	17.62	3.45	20	19.51	3.98	19	20.02	4.85	17
100 mg/kg	11.01	2.64	19	14.54	3.98	19	16.10	4.07	16	17.00	4.65	14	17.86	5.20	13

twenty-nine (Table 20) of these were examined to determine if an annulus formed each year and 36 (Table 21) were used to test the readers' interpretation of annuli. Fish used in the total sample had been at liberty for 2 to 4 yr. Most had completed three growing seasons and a few had completed four growing seasons. Thus there should be between two and four annuli distal of the oxytetracycline mark.

The oxytetracycline mark was visible on the broken sections of most otoliths. In some there was no mark and all otoliths that had fungal growth resulting from improper cleaning prior to storage did not have a mark.

In this study 65% of the recovered fish were either the same size or shorter than the size at tagging. While measurement error and shrinkage during storage occur (Beamish et al. 1980), there can be little doubt that growth in length of the fish has been very small during the release period and that the narrow annual growth increments on the otolith are an accurate indication of slow growth.

The annual growth zones in the vicinity of the oxytetracycline mark were quite narrow (Fig. 17). In a few cases the mark appeared to be on the edge of the section. The very narrow annual growth zones are common in older fish and suggest that fish growth also is reduced (Beamish and Chilton 1982). Annuli, distal of the oxytetracycline mark, could be counted on 74% of the subsample of 129 fish (Table 20). In almost all cases (90%) where annuli could be identified distal of the oxytetracycline mark it was possible to identify the expected number of annuli (Table 20).

The expected number of annuli was accurately determined in 36% of the subsample (Table 21) that was aged so that the reader could not be influenced by knowing that the fish had been at liberty for 3 yrs. The expected number of annuli, $\pm$ 1 year were determined correctly in 75% of the sample. In no case was the estimate of the number of annuli that formed while at liberty sufficiently large that one would consider that many growth zones formed each year resulting in an overestimate of age.

Errors that occurred clearly resulted from the difficulty of identification and the interpretation of growth zones. While it was necessary to consider how to group some growth zones, it usually was possible to distinguish checks from the wider, more prominent annuli.

For example, fish no. B7720670 (Fig. 17) was a female tagged in June 1978 and recovered in June 1981. Since most growth occurs in the summer months, this fish was at liberty for three growing seasons. Length at tagging was 79 cm but no length at recovery was obtained. The oxytetracycline mark is clearly visible on the interior surface and the annuli before and after the mark are visible. (The annuli are more difficult to identify from photographs than from freshly broken and burnt sections.) Note that the oxytetracycline mark has formed only on the interior surface, indicating that most otolith growth is confined to the interior surface. That is, otolith growth is primarily in thickness and not in length or width or both.

Fish B7725711 was a female tagged in June 1978 and recovered in July 1981. It had been at liberty for three growing seasons and increased in length from 81 to 82.5 cm. The oxytetracycline mark was close to the edge on

Table 20. Estimated years at liberty for tagged and injected sablefish. Reader was aware of expected number of annuli.

Expected number of annuli during liberty	Actual number of annuli (parenthesis)	Number with mark on or close to edge	Number with no mark
2	(1) (2) (3) - 7 -	8	4
3	(2) (3) (4) 4 67 5	20	9
4	(3) (4) (5) - 4 -	-	1

Table 21. Estimated years at liberty for tagged and injected fish that had been at liberty for 3 growing seasons. Reader was unaware of expected number of annuli.

Estimated years at liberty	0	1	2	3	4	unreadable
No.	2	6	9	13	5	1
%	6	17	25	36	14	3

the interior surface and on the edge on the dorsal, ventral and exterior surface. The interpretation of annuli proximal and distal to the mark is difficult but typical. The broken and burnt section (Fig. 18) indicates that checks can cause some difficulty in identifying the annuli that form when the fish is younger but checks become less of a problem with age. Checks are not prominent in all areas of the otolith while annuli remain identifiable whenever growth zones can be distinguished.

The mean width of the three annuli proximal to the oxytetracycline mark in the sample of 36 fish was 0.57 mm compared to 0.46 mm distal to the mark. While these widths appear similar, they are significantly different (t-test, $P<0.01$). When a sample of 50 untagged fish was examined the mean width of the last three annuli was 0.46 mm while the group of three annuli immediately preceding the last three annuli was 0.62 mm. Again the widths of the last (older) group of three annuli is significantly smaller (t-test, $P<0.01$). The smaller widths of annuli or groups of annuli that form as the fish ages are consistent with asymptotic growth of fishes. The similarity of response of otolith growth of tagged and untagged fish and the absence of a major or abrupt change in growth pattern after tagging is indicative that tagging and injecting has not had a major effect on growth of the otolith and that the observations from tagged and injected fish are representative of untagged fish. The study of annual growth increments on the otolith in relation to fish growth is continuing.

Because of the slow growth of the otolith and the narrow spacing of the annuli distal to the oxytetracycline mark, we feel that fish must be at liberty for longer periods before we are totally confident of the validity of our interpretation. The evidence to date does suggest that the method is valid. There is no evidence of serious overestimates of age, and fish that ranged from 4 to 43 yrs old when tagged added the approximate number of annuli equivalent to the time at liberty. The comparison of annuli width of tagged and injected fish and untagged fish indicated that while there is a difference in the amount of otolith growth following tagging and injecting, the difference is not large and probably represents the normal asymptotic decrease in growth with age. Thus, while the age determination method can be difficult because of interpretation difficulties, it appears valid.

GROWTH USING TAGGING AND RECAPTURE MEASUREMENTS

As reported previously (Beamish et al. 1980) the measurements of recovered blackcod indicate there has been no net increment in length no matter how long the fish have been at liberty (Table 22) and if all measurements are used there has been a net decrease in some length groups. The absence of a net increase is related to shrinkage during freezing. If fish were measured immediately upon recovery without freezing then there was a definite trend to a net increase in length with time (Table 22). Freshly measured fish that had been at liberty for more than one year grew at an average annual increment of 0.65 cm/yr (Table 22). If the fresh measurements of fish receiving an OTC injection are compared with those of fish that did not (Table 23), there was a significant difference (t-test, $P<0.05$) in mean annual increments. If only fresh measurements of uninjected recoveries are

Fig. 17. Section of otolith from sablefish B7720670.

Fig. 17A shows the section after burning. Fig. 17B shows the OTC mark that is yellow under ultraviolet light. Fig. 17C is an enlargement of the growth zones that formed before and after the OTC mark.

B 7720670

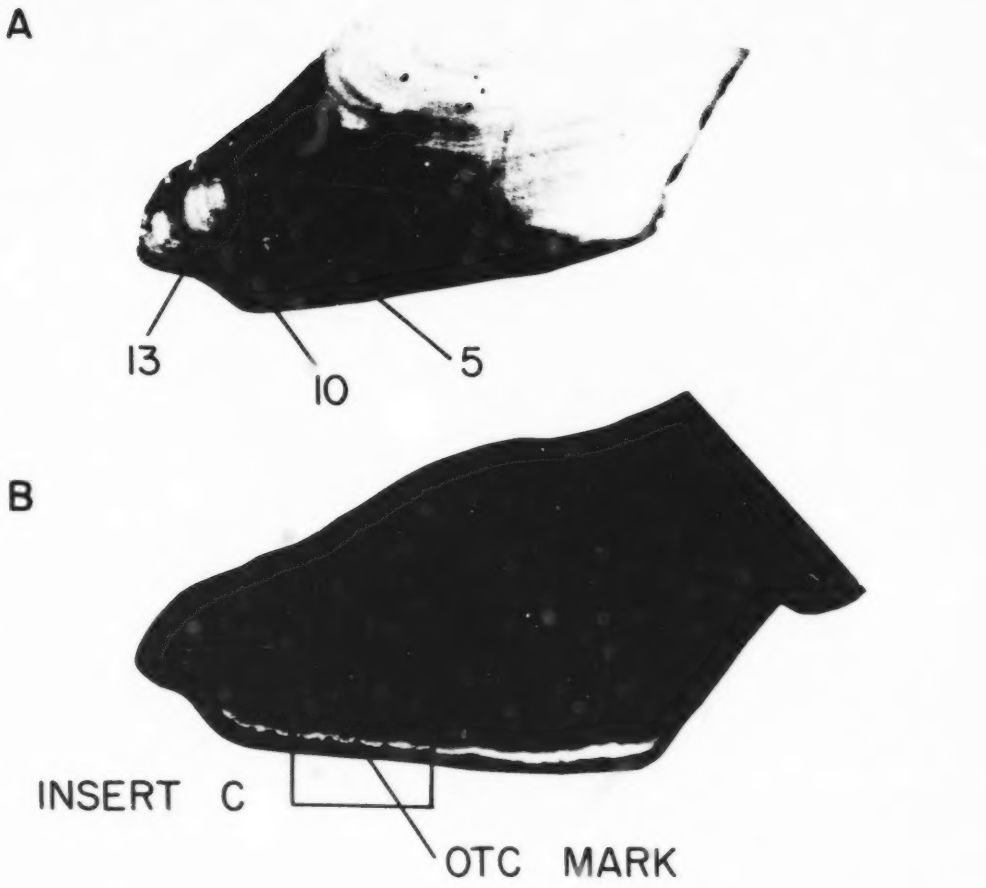

A
13
10
5
B
INSERT C
OTC MARK
C
10 (1977)
OTC MARK
CHECK
1978
1979
1980

Fig. 18. Section of otolith from sablefish B7725711. Fig. 18A shows the OTC mark that is yellow under ultraviolet light. Fig. 18B shows the section after burning. Fig. 17C is an enlargement of the growth zones that formed before and after the OTC mark.

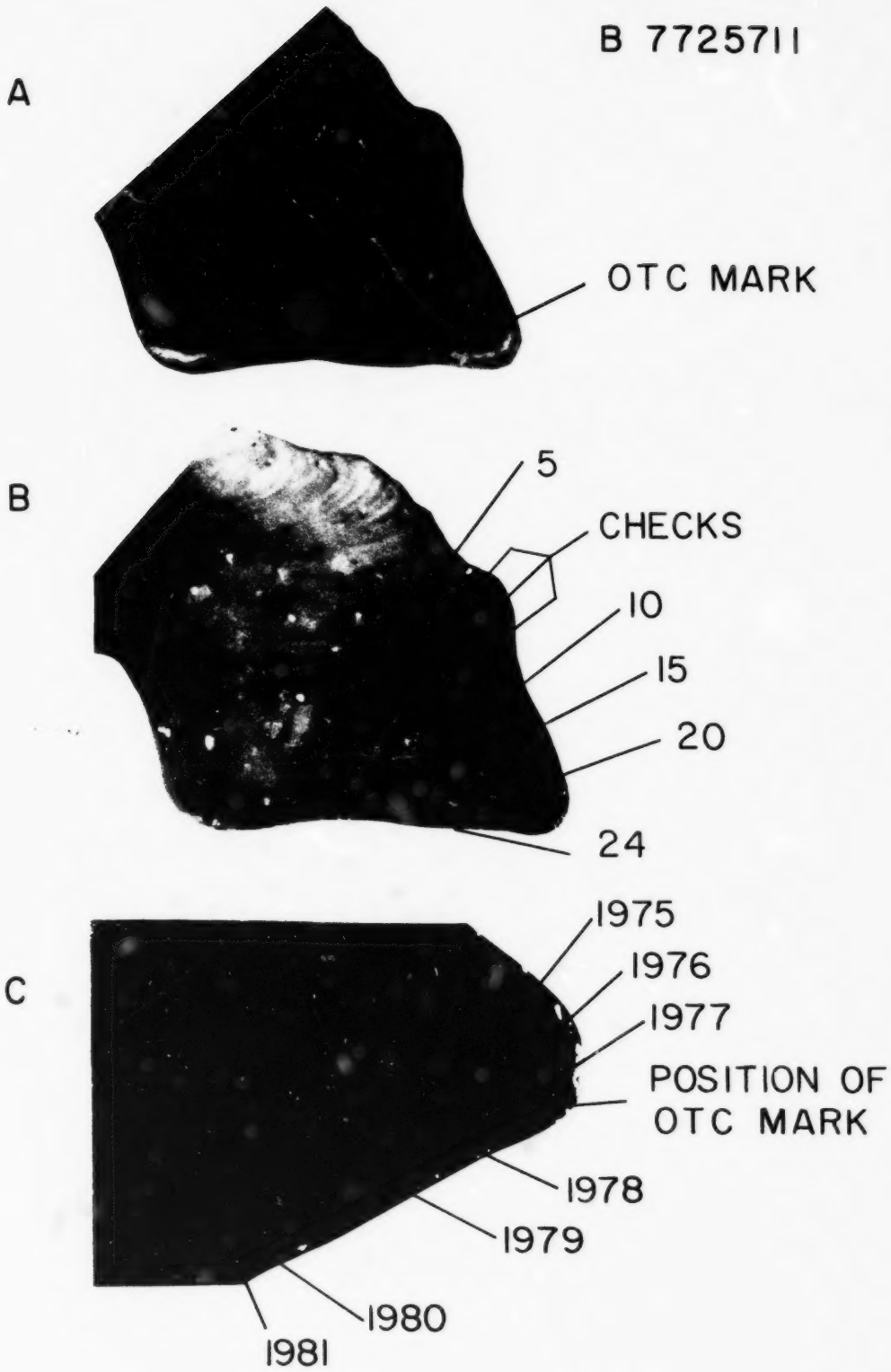

B 7725711
A
OTC MARK
B
5
CHECKS
10
15
20
24
C
1975
1976
1977
POSITION OF
OTC MARK
1978
1979
1980
1981

Table 22. Average growth of recovered sablefish.

Years after tagging	All recovered sablefish			Only sablefish measured by fisheries staff in fresh condition		
	Average growth (cm)	S.D.	N.	Average growth (cm)	S.D.	N.
0	-0.63	2.14	820	0.99	2.91	51
.5	-0.25	1.95	1324	0.52	1.81	136
1.0	-0.51	2.30	1490	0.43	2.63	38
1.5	-0.53	2.33	425	0.99	2.81	19
2.0	-0.62	2.40	328	0.61	1.54	36
2.5	-0.62	2.97	83	-0.18	0.87	11
3.0	-0.99	2.77	128	6.1	5.88	5
3.5	-1.5	0.71	2	-	-	-

Table 23. Average growth (cm) of recovered sablefish with release length greater or equal to 60 cm, and measured in fresh condition by fisheries staff. (Includes recoveries up to December 31, 1981.)

Number of growing seasons[a] at large	Uninjected fish				Injected fish				Total			
	x annual increment	x growth	S.D.	n	x annual increment	x growth	S.D.	n	x annual increment	x growth	S.D.	n
Males												
1	0.48	0.48	1.7	28	-0.67	-0.67	1.2	6	0.28	0.28	1.7	34
2	0.16	0.31	1.0	21	0.40	0.80	1.3	5	0.21	0.41	1.0	26
3	0.76	2.27	2.0	3	-0.17	-0.50	0.7	2	0.39	1.16	2.1	5
x annual increment	0.47				-0.15				0.29			
Females												
1	0.54	0.54	1.6	58	-0.05	-0.05	1.2	21	0.38	0.38	1.5	79
2	0.44	0.87	3.3	45	0.85	1.70	1.7	10	0.51	1.02	3.1	55
3	0.95	2.86	2.1	5	0.12	0.35	2.0	6	0.50	1.49	2.3	11
4	1.39	5.56	6.6	5	0.93	3.70	0.0	1	1.31	5.25	6.0	6
5	0.80	4.00	4.9	2	-	-	-	-	0.80	4.00	4.9	2
x annual increment	0.80				0.46				0.70			

[a]Growing season taken as June to September.

considered, the mean annual increment for males (0.47cm), as expected is less than for females (0.80 cm).

Combining samples by time at liberty rather than age can bias the results if unequal numbers of younger faster growing fish are recovered. However, at this time we wanted to show only that sablefish grow very slowly, corroborating the estimates of growth from age analysis (Fig. 19). As more fish are recovered, the growth increments during liberty can be compared by age groups.

BIOLOGICAL DATA OF SABLEFISH FROM "OFFSHORE" AND "INSIDE" WATERS COLLECTED DURING TAGGING CRUISES

A total of 33,704 sablefish were sampled for length from the four offshore tagging cruises and the two inshore tagging cruises for juveniles conducted in 1980 (Table 24). Of these, 3568 were also examined for sex, 3500 for maturity and 2989 were sampled for otoliths. A total of 1948 adults and juveniles were examined for stomach contents. Weights were taken for 101 fish.

During 1981, a total of 27,080 sablefish were sampled for length from three offshore tagging cruises and one tagging cruise for juveniles conducted in Hecate Strait and Queen Charlotte Sound in August (Table 25). A total of 4350 were examined for sex and maturity state and 2081 of these were sampled for otoliths. Weights were taken from a sample of 200 fish from the west coast Queen Charlotte Islands in June.

LENGTH

In 1980, the size composition of sablefish was similar for similar areas (Fig. 12) in 1981 (Fig. 20). The total length distribution of sablefish off the Queen Charlotte Islands ranged from 41 to 104 cm and 45 to 101 cm respectively. As previously noted (Beamish et al. 1978, 1979, 1980) the mean lengths by sex indicate that females attain larger sizes than males. Less than 11% of the males were larger than 70 cm whereas 56.5% of the females were larger than 70 cm (Fig. 21, 22, 27, 28). The mean length of males sampled increased from 62 cm in 1980 to 63.7 cm in 1981. The sample of females increased in mean length from 70.2 cm in 1980 to 72.8 cm in 1981.

Samples collected from Queen Charlotte Sound in 1980 and 1981 have a length distribution similar to that of Queen Charlotte Islands. The total length distribution ranged from 45-90 cm for 1980 (Fig. 23-24) and 49-104 cm in 1981 (Fig. 29). In 1981, the mean length for males was 61.3 cm and 73.5 cm for females, similar to the Queen Charlotte Island samples. However, males larger than 70 cm are less than 8% of the sample and 63.3% of the females are larger than 70 cm.

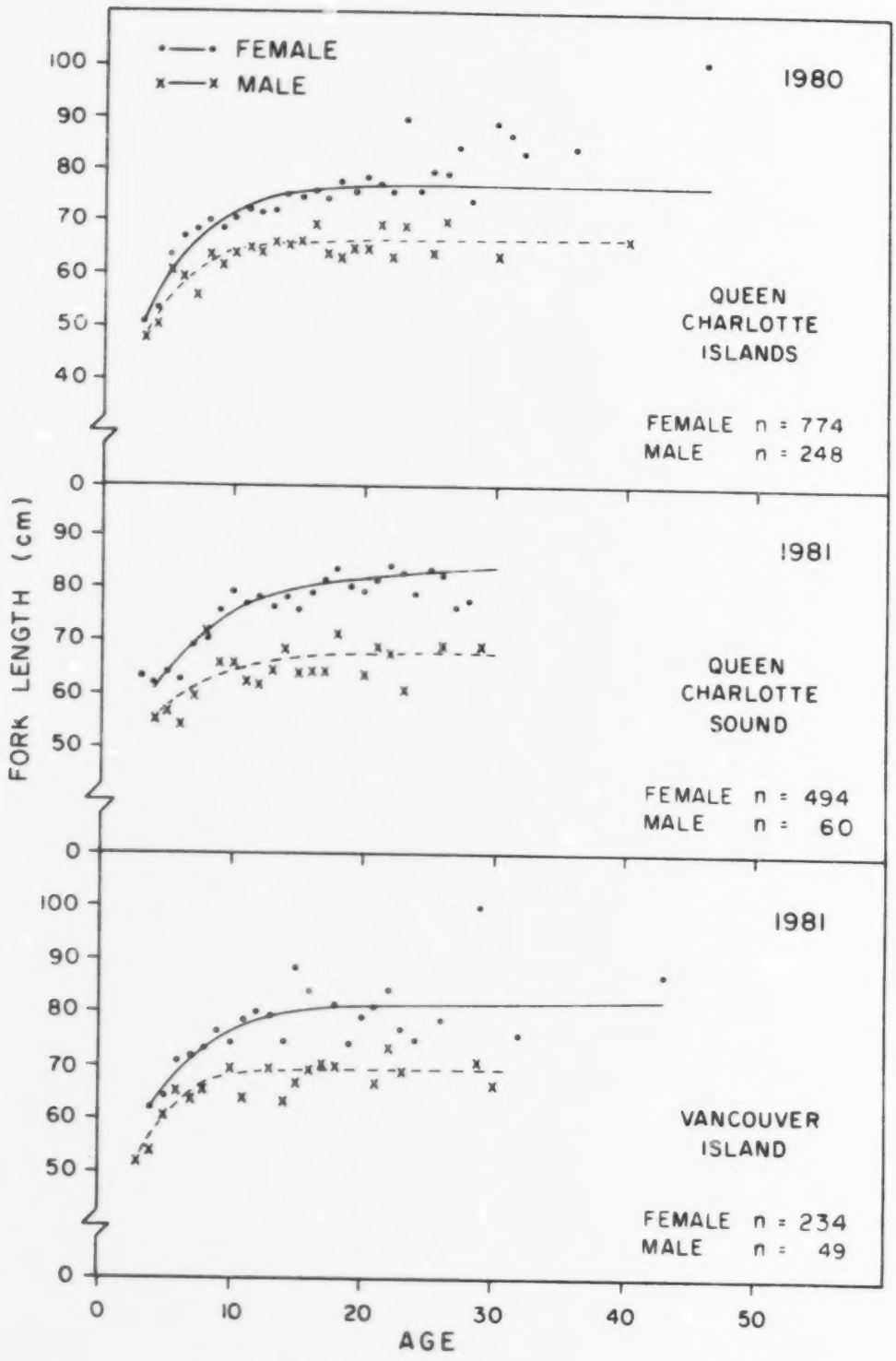


Fig. 19. Growth curves (Von Bertalanffy) of sablefish sampled off Queen Charlotte Islands, Queen Charlotte Sound, and Vancouver Island, 1980-1981.

Table 24. Summary of sablefish sampled on tagging cruises, 1980.

Cruise	Length	Weight	Sex		M:F	Maturity	Stomach contents	Otoliths
			M	F				
West coast Queen Charlotte Islands (TALAPUS, Jan-Feb)	2,926	51	338	1,060	1:3.1	1,386	885	1,240
Queen Charlotte Sound (TALAPUS, March)	3,159	-	13	33	1:2.5	46	1	-
North west coast Vancouver Island (LA PORSCHE, March)	4,922	50	64	95	1:1.5	159	102	102
Central Inlets of B.C. (WESTERLY WIND, May)	7,381	-	152	207	1:1.4	359	299	295
West coast Queen Charlotte Islands and Dixon Entrance (VIKING STAR, June-July)	3,699	-	733	405	1.8:1	1,138	193	1,152
Hecate Strait, Queen Charlotte Sound (PACIFIC TRIDENT, Sept-Oct)	11,617	-	224	244	1:1.1	412	468	200
Total for year	33,704	101	1,524	2,044	1:1.3	3,500	1,948	2,989

Table 25. Summary of sablefish sampled on tagging cruises, 1981.

Cruise	Length	Weight	Sex		M:F	Maturity	Stomach contents	Otoliths
			M	F				
West coast Queen Charlotte Islands (LA PORSCHE, March)	3,112	-	-	-	-	-	-	-
West coast Queen Charlotte Islands (SEAPAK, June)	3,108	200	70	130	1:1.9	200	-	200
Hecate Strait, Queen Charlotte Sound (G.B. REED, August)	12,506	-	101	99	1:1	200	-	200
West coast QCI	5,338	-	327	601	1:1.8	928	-	481
Queen Charlotte Sound	1,240	-	261	979	1:3.8	1,240	-	600
West coast VI (OCEAN PEARL, November)	1,782	-	345	1,437	1:4.2	1,782	-	600
Total for year	27,086	200	1,104	3,246	1:2.9	4,350	-	2,081

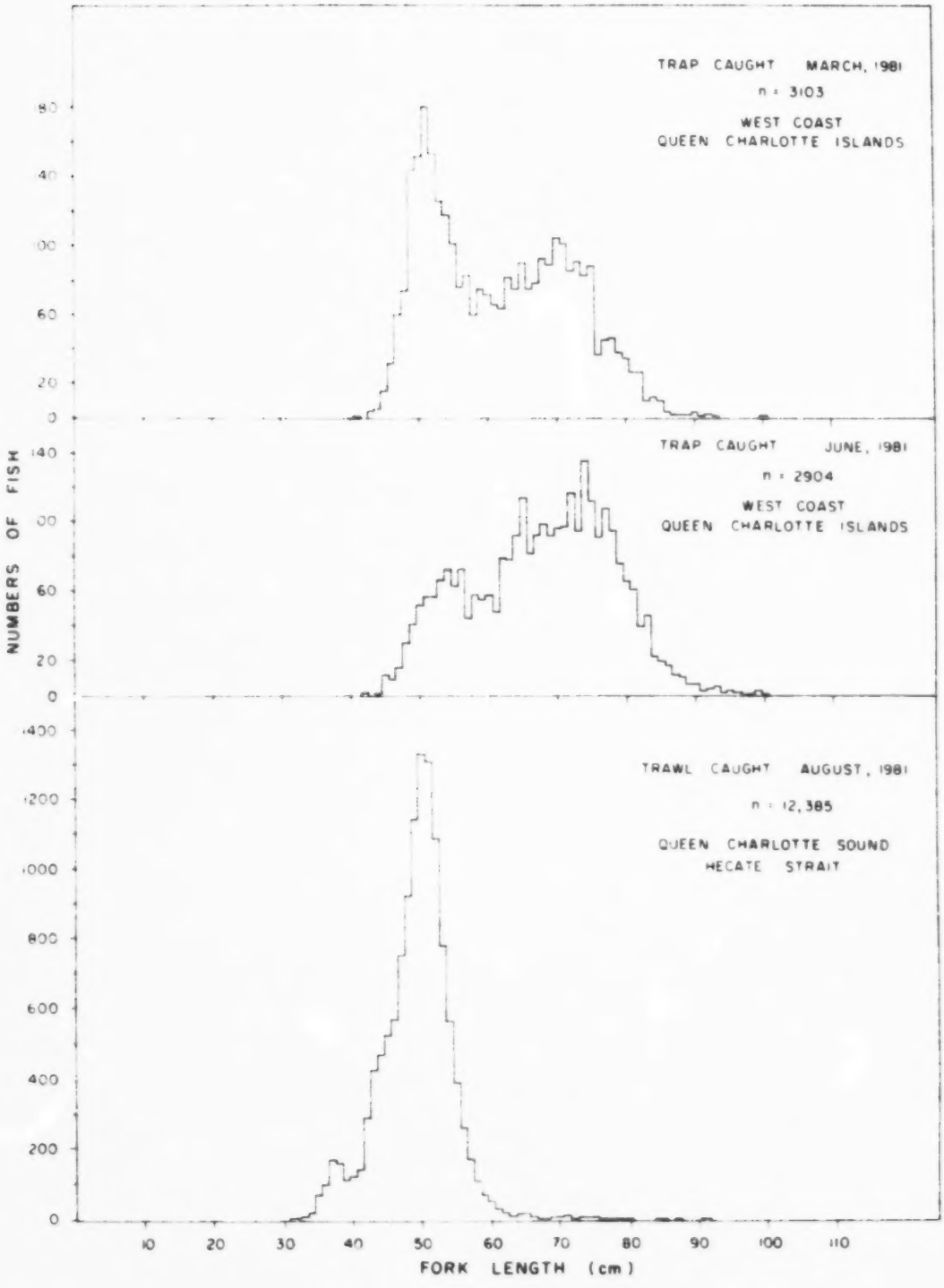


Fig. 20. Length frequencies of sablefish tagged in March, June, August and November, 1981.

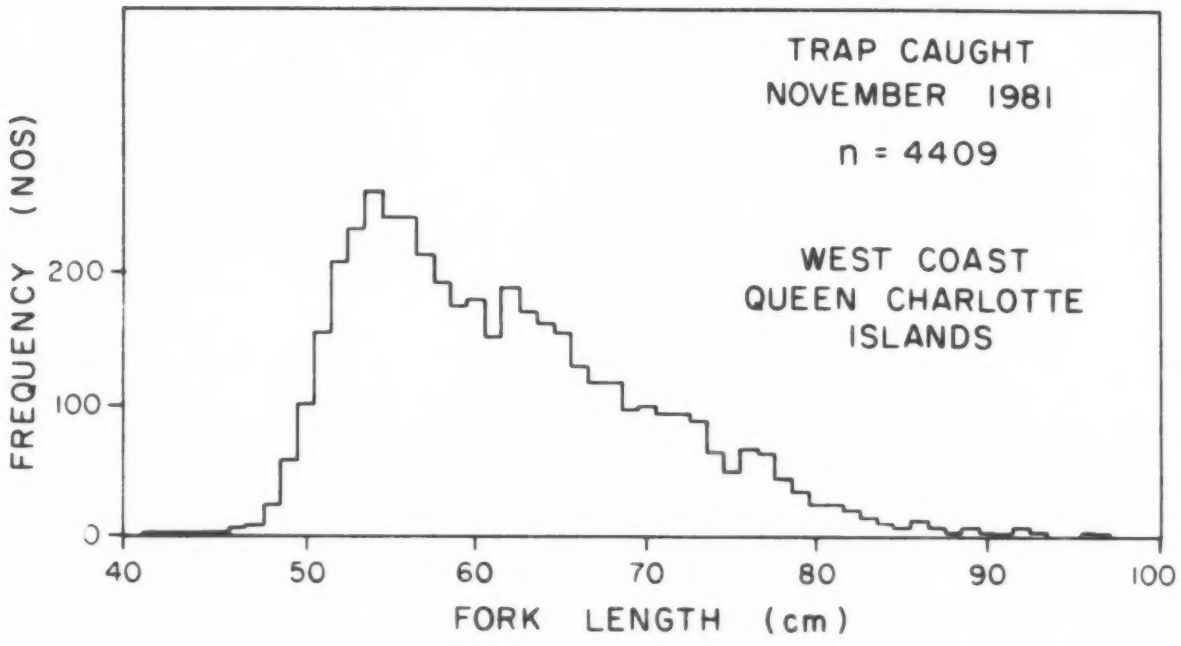


Fig. 20 continued.

Fig. 21. Length-sex frequency of sablefish sampled off the west coast of the Queen Charlotte Islands, January-February 1980.

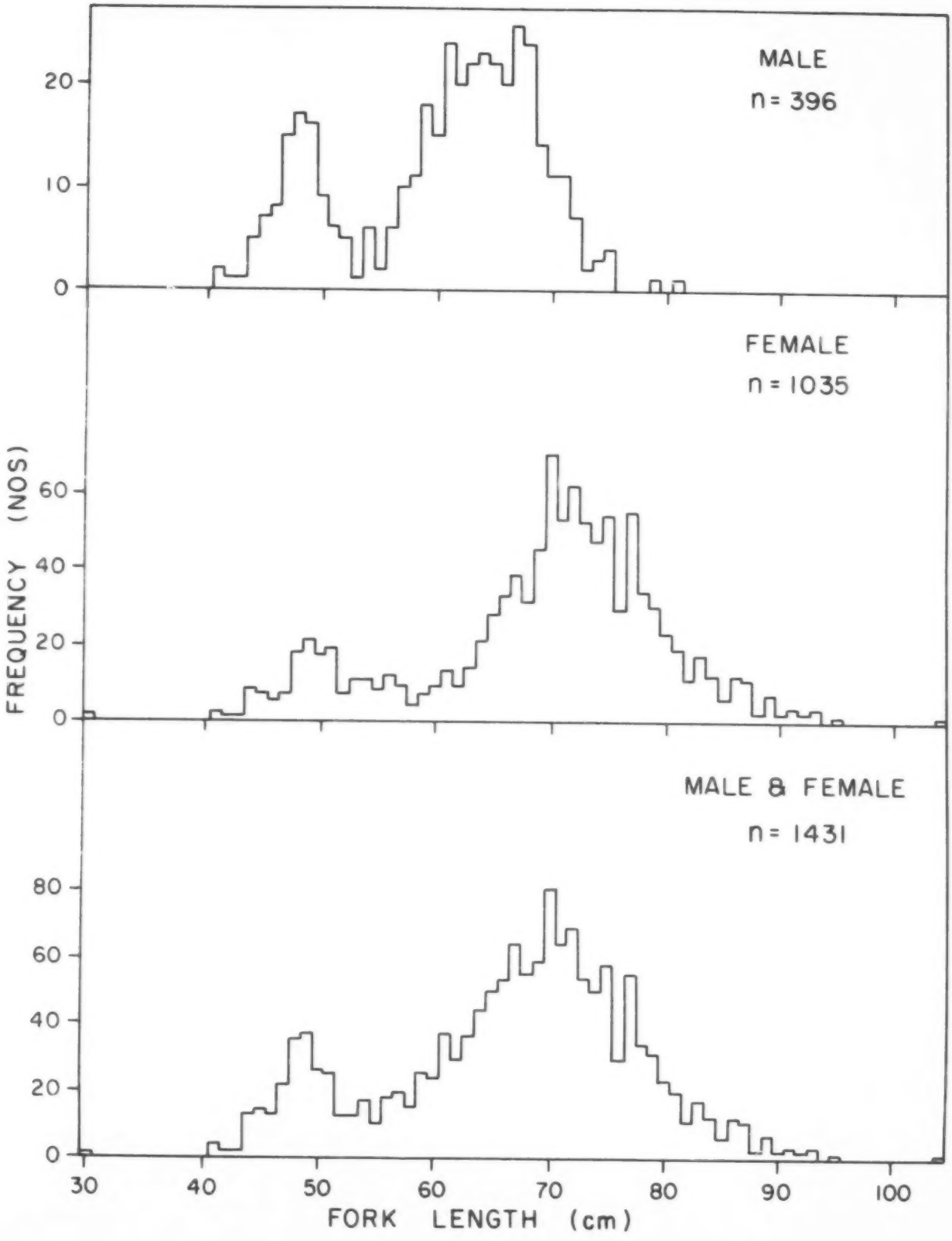

MALE
n = 396
FEMALE
n = 1035
MALE & FEMALE
n = 1431
FREQUENCY (NOS)
FORK LENGTH (cm)
0
10
20
40
60
80
30
40
50
60
70
80
90
100

Fig. 22. Length-sex frequency of sablefish sampled off the west coast of the Queen Charlotte Islands, June-July, 1980.

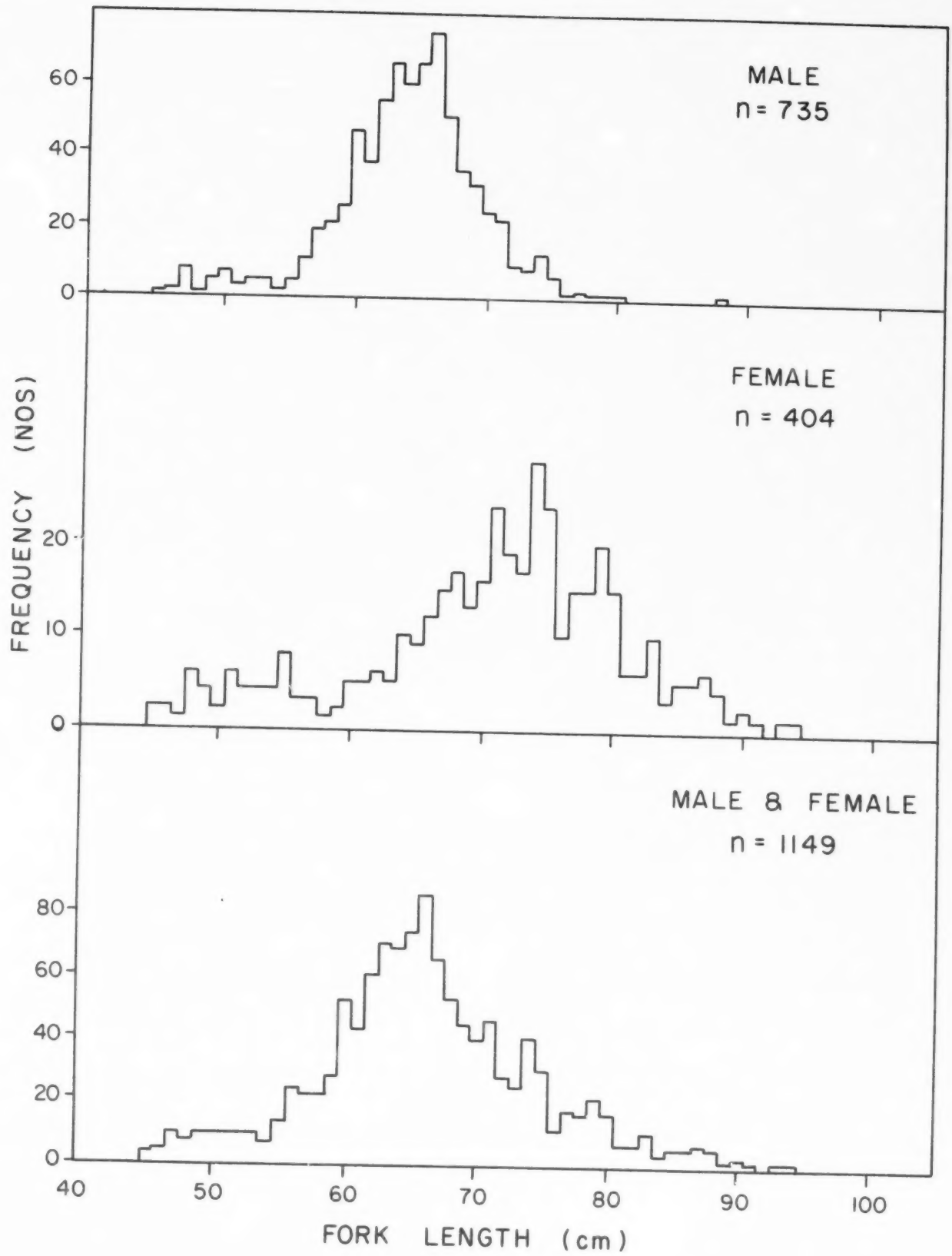

MALE
n = 735
FEMALE
n = 404
MALE & FEMALE
n = 1149
FREQUENCY (NOS)
FORK LENGTH (cm)
0
20
40
60
10
80
100
50
70
90

Fig. 23. Length-sex frequency of sablefish sampled off Queen Charlotte Sound, March 1980.

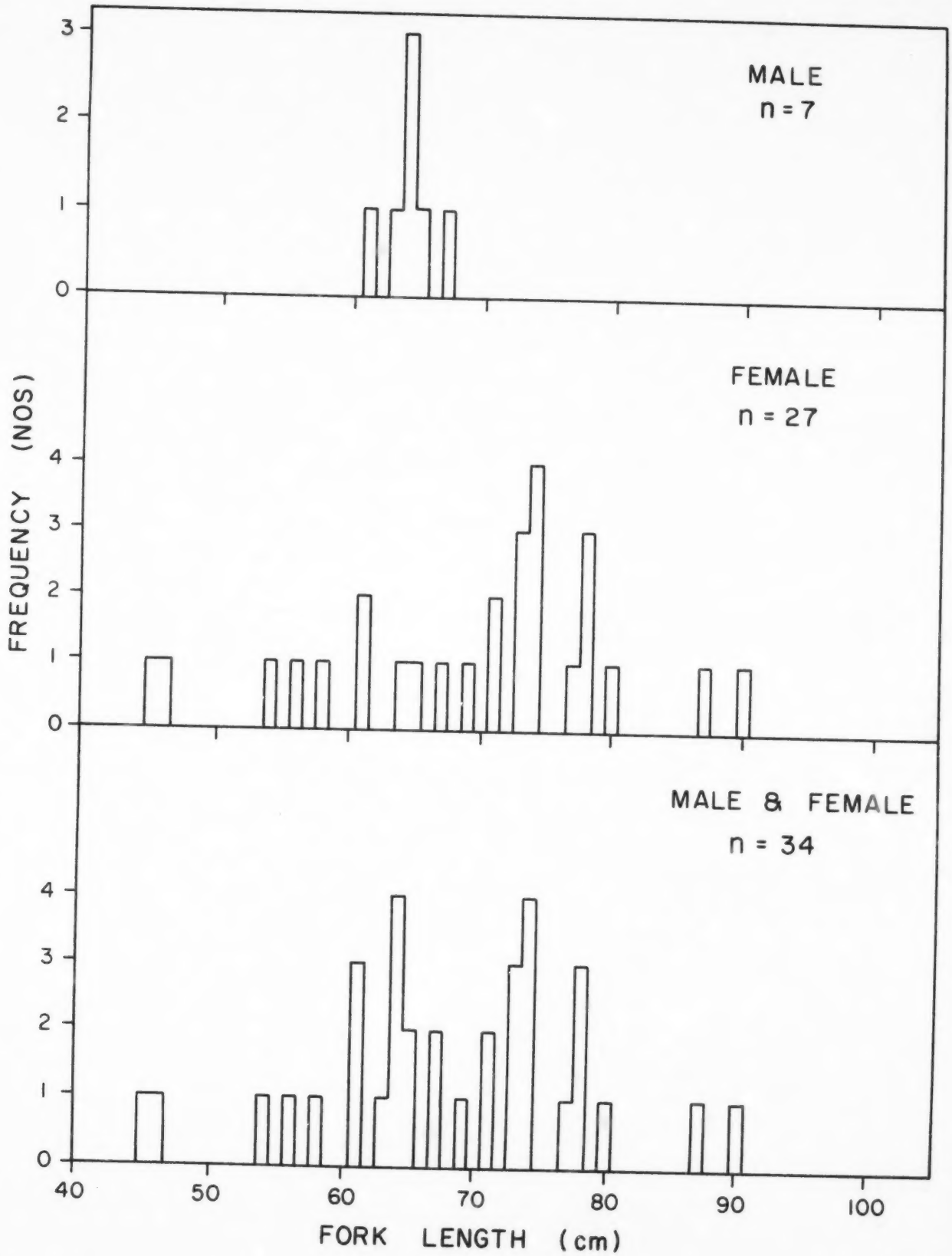

MALE
n = 7
FEMALE
n = 27
MALE & FEMALE
n = 34
FREQUENCY (NOS)
FORK LENGTH (cm)
0
1
2
3
4
40
50
60
70
80
90
100

Fig. 24. Length-sex frequency of sablefish sampled in Hecate Strait-Queen Charlotte Sound, September-October 1980.

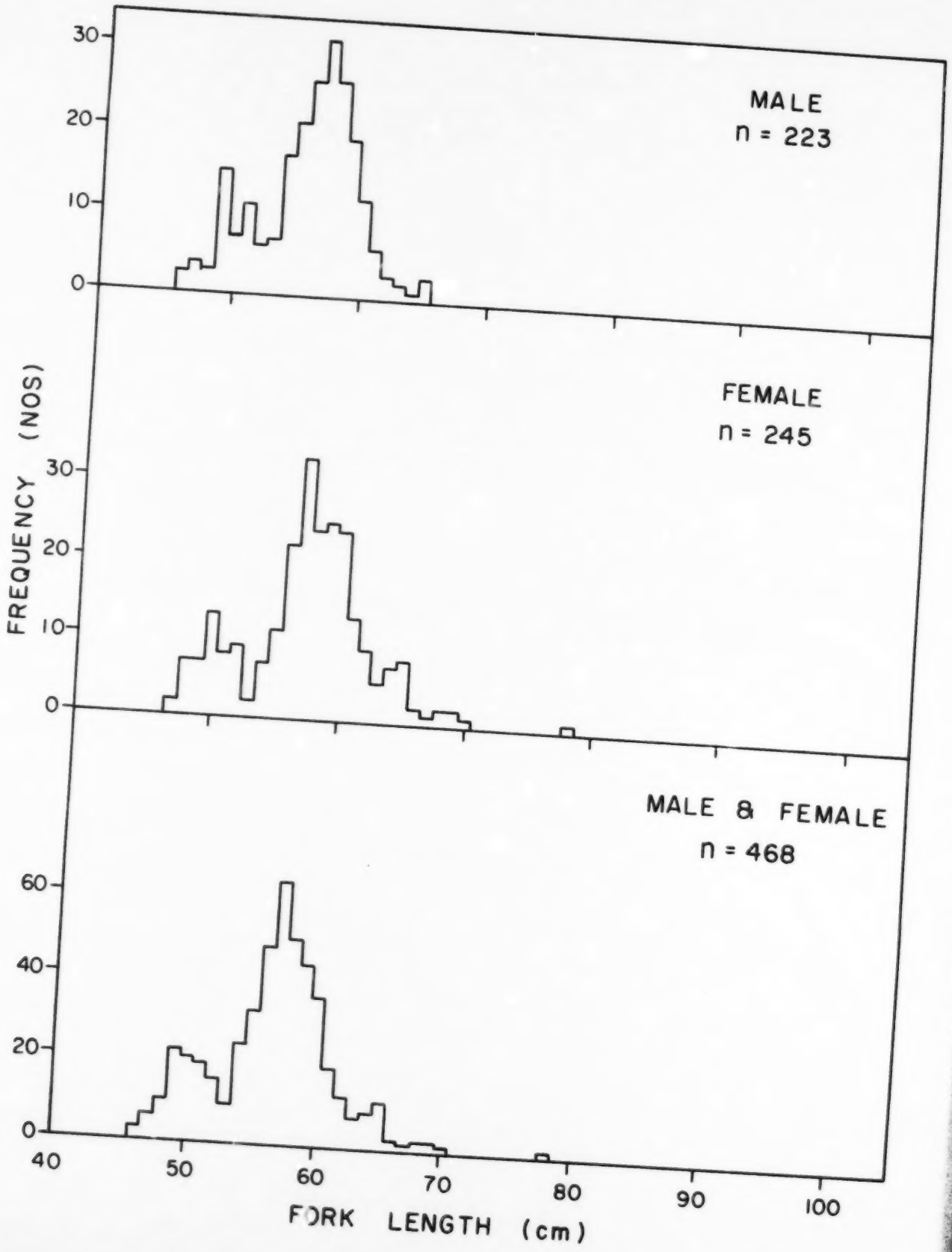

MALE
n = 223
FEMALE
n = 245
MALE & FEMALE
n = 468
FREQUENCY (NOS)
FORK LENGTH (cm)
0
10
20
30
40
50
60
70
80
90
100

Fig. 25. Length-sex frequency of sablefish sampled in Hecate Strait and central inlets. May 1980.

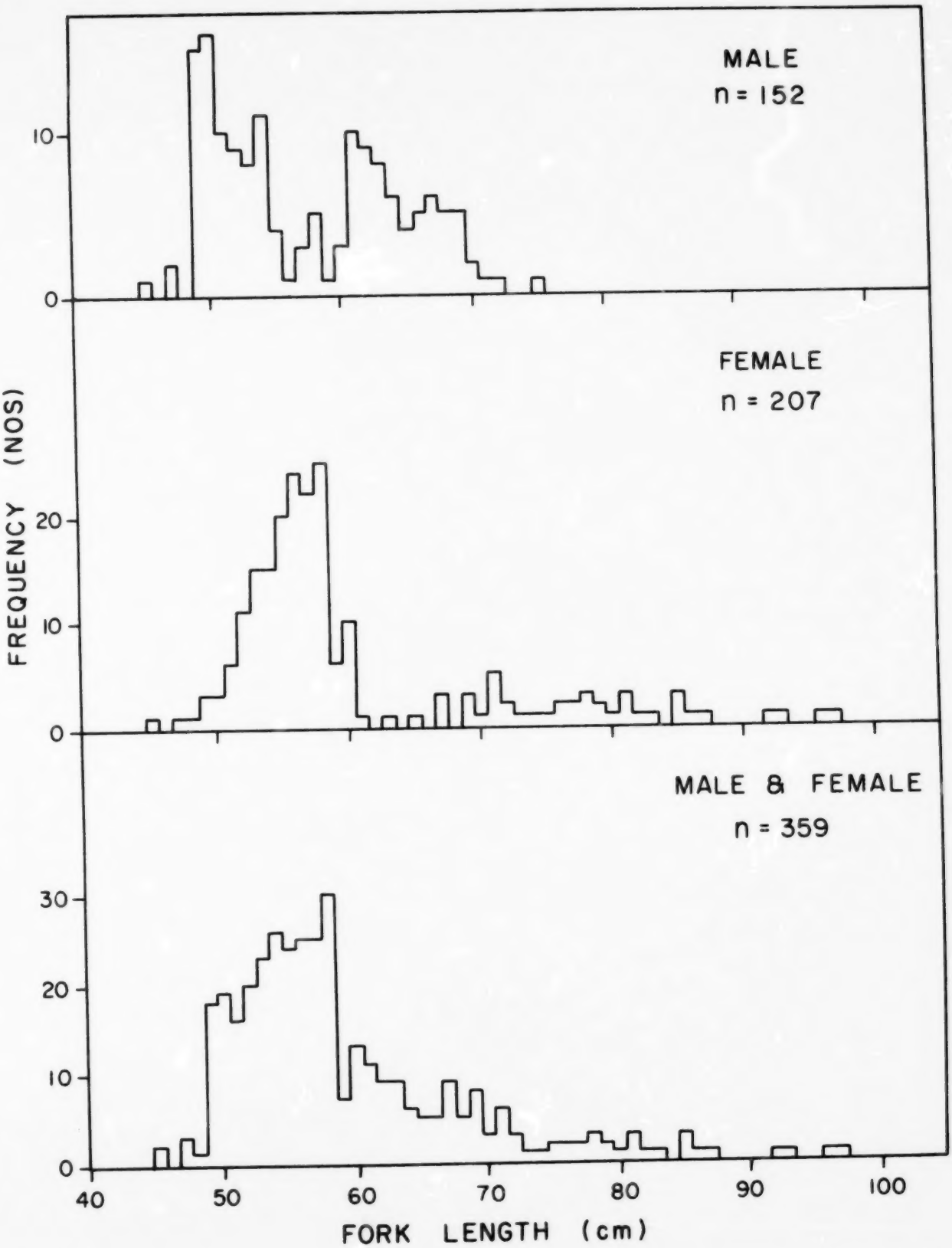

MALE
n = 152
FEMALE
n = 207
MALE & FEMALE
n = 359
FREQUENCY (NOS)
FORK LENGTH (cm)
0
10
20
30
40
50
60
70
80
90
100

Fig. 26. Length-sex frequency of sablefish sampled off the west coast of Vancouver Island. March 1980.

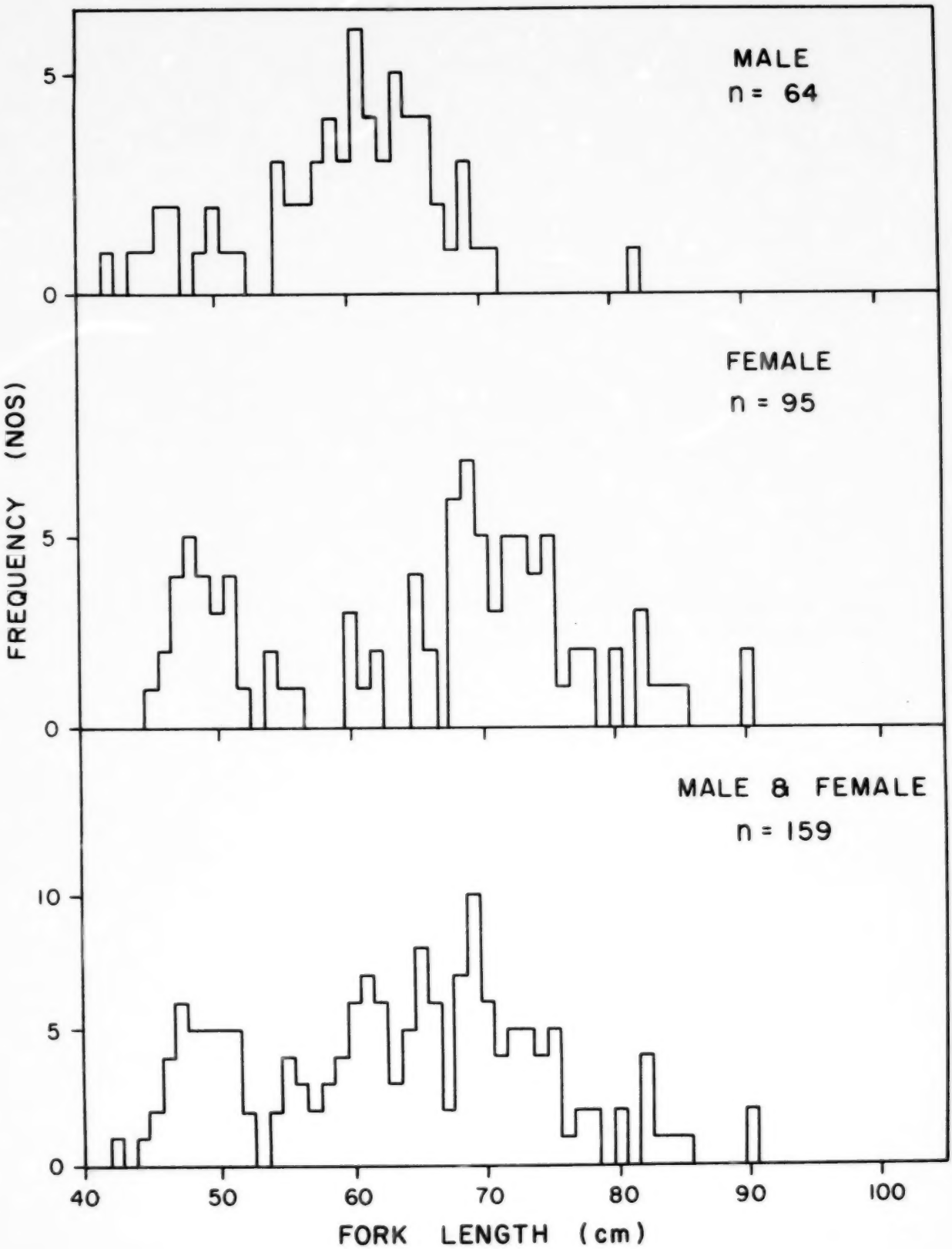

MALE
n = 64
FEMALE
n = 95
MALE & FEMALE
n = 159
FREQUENCY (NOS)
FORK LENGTH (cm)
0
5
10
40
50
60
70
80
90
100

Fig. 27. Length-sex frequency of sablefish sampled off the west coast of the Queen Charlotte Islands. June, 1981.

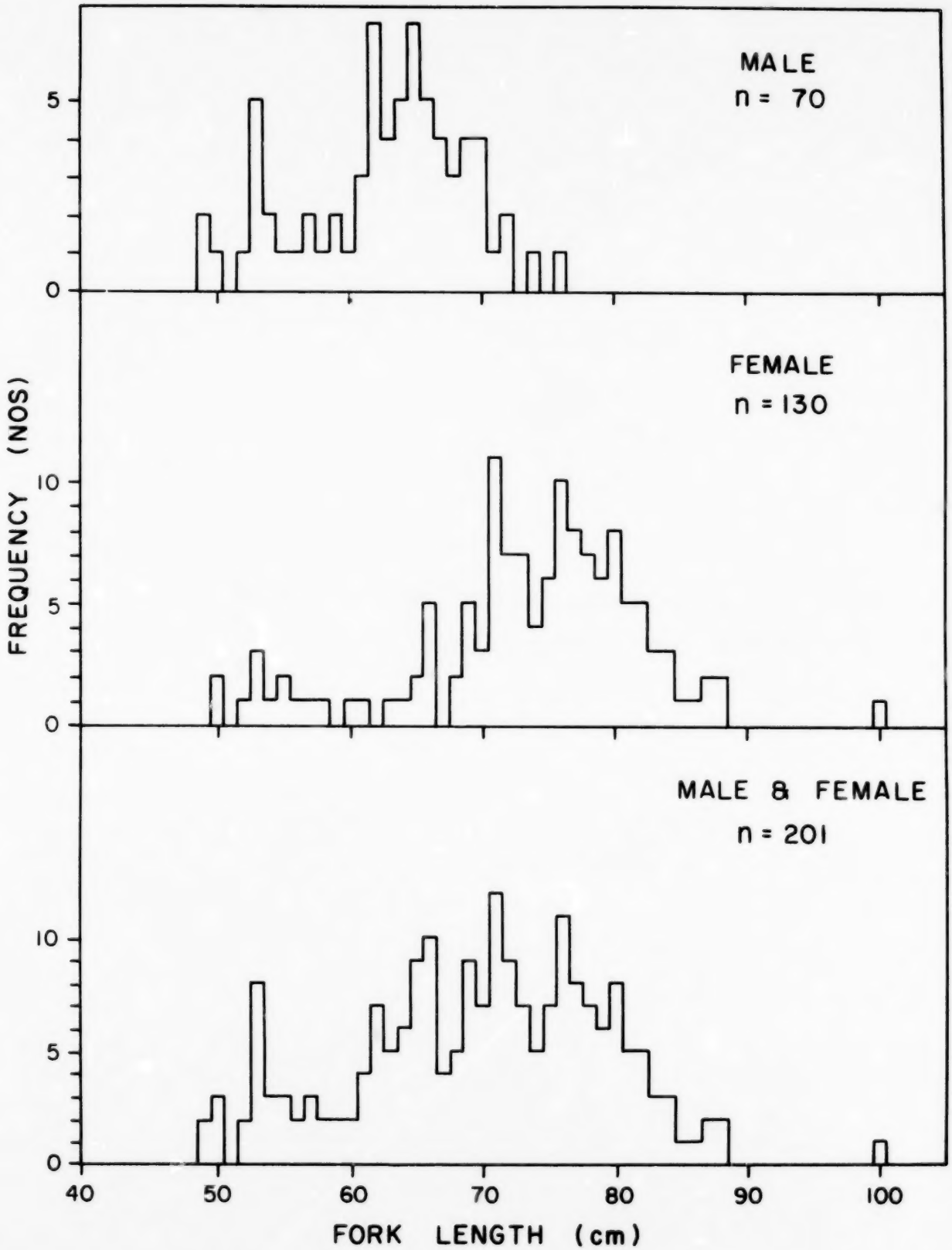

MALE
n = 70
FEMALE
n = 130
MALE & FEMALE
n = 201
FREQUENCY (NOS)
0
5
10
40
50
60
70
80
90
100
FORK LENGTH (cm)

Fig. 28. Length-sex frequency of sablefish sampled off the west coast of the Queen Charlotte Islands. November 1981.

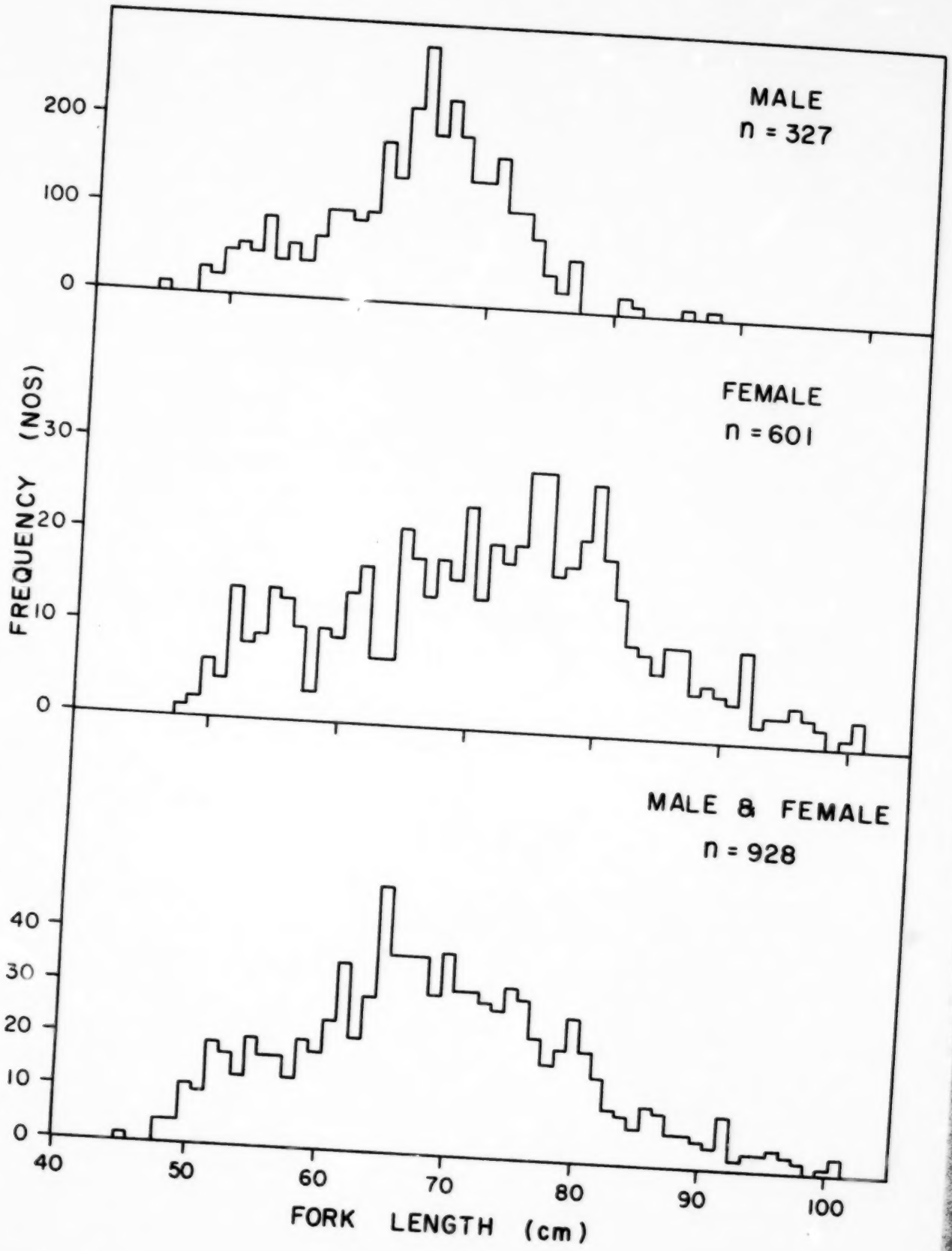
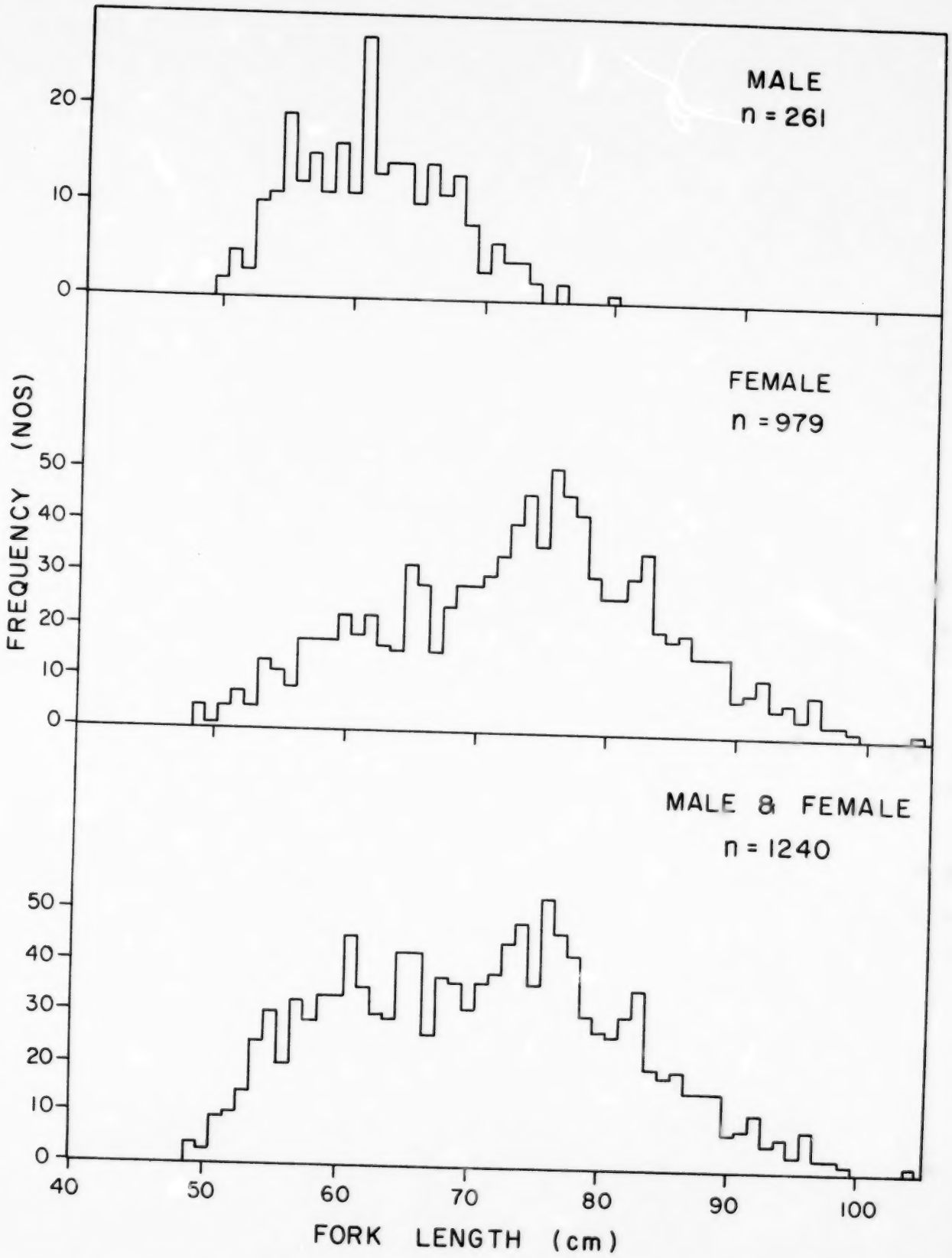

MALE
n = 327
FEMALE
n = 601
MALE & FEMALE
n = 928
FREQUENCY (NOS)
FORK LENGTH (cm)
200
100
0
30
20
10
0
40
30
20
10
0
40
50
60
70
80
90
100

Fig. 29. Length-sex frequency of sablefish sampled off Queen Charlotte Sound. November 1981.


MALE
n = 261
FEMALE
n = 979
MALE & FEMALE
n = 1240
FREQUENCY (NOS)
FORK LENGTH (cm)
0
10
20
30
40
50
40
50
60
70
80
90
100

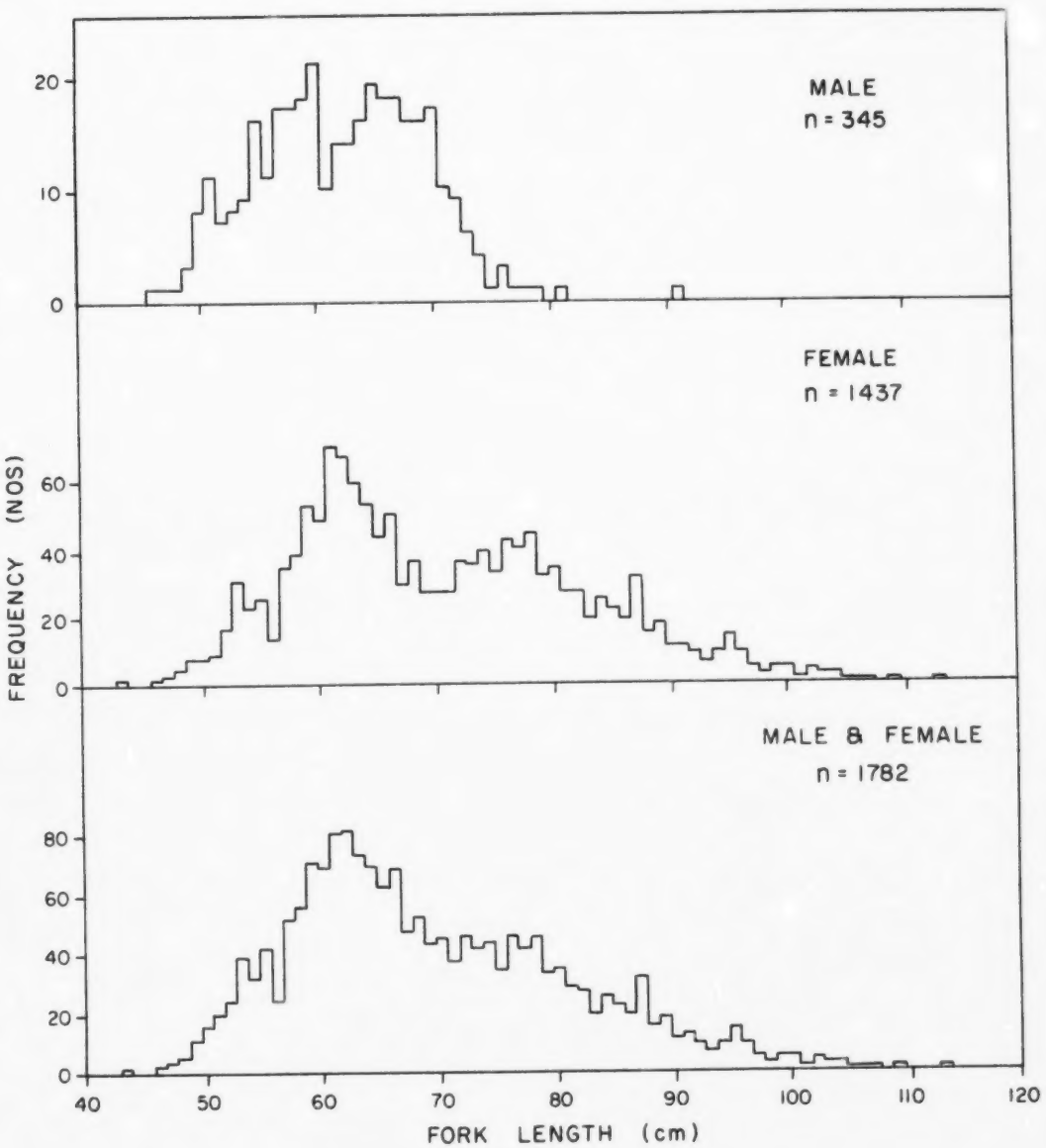
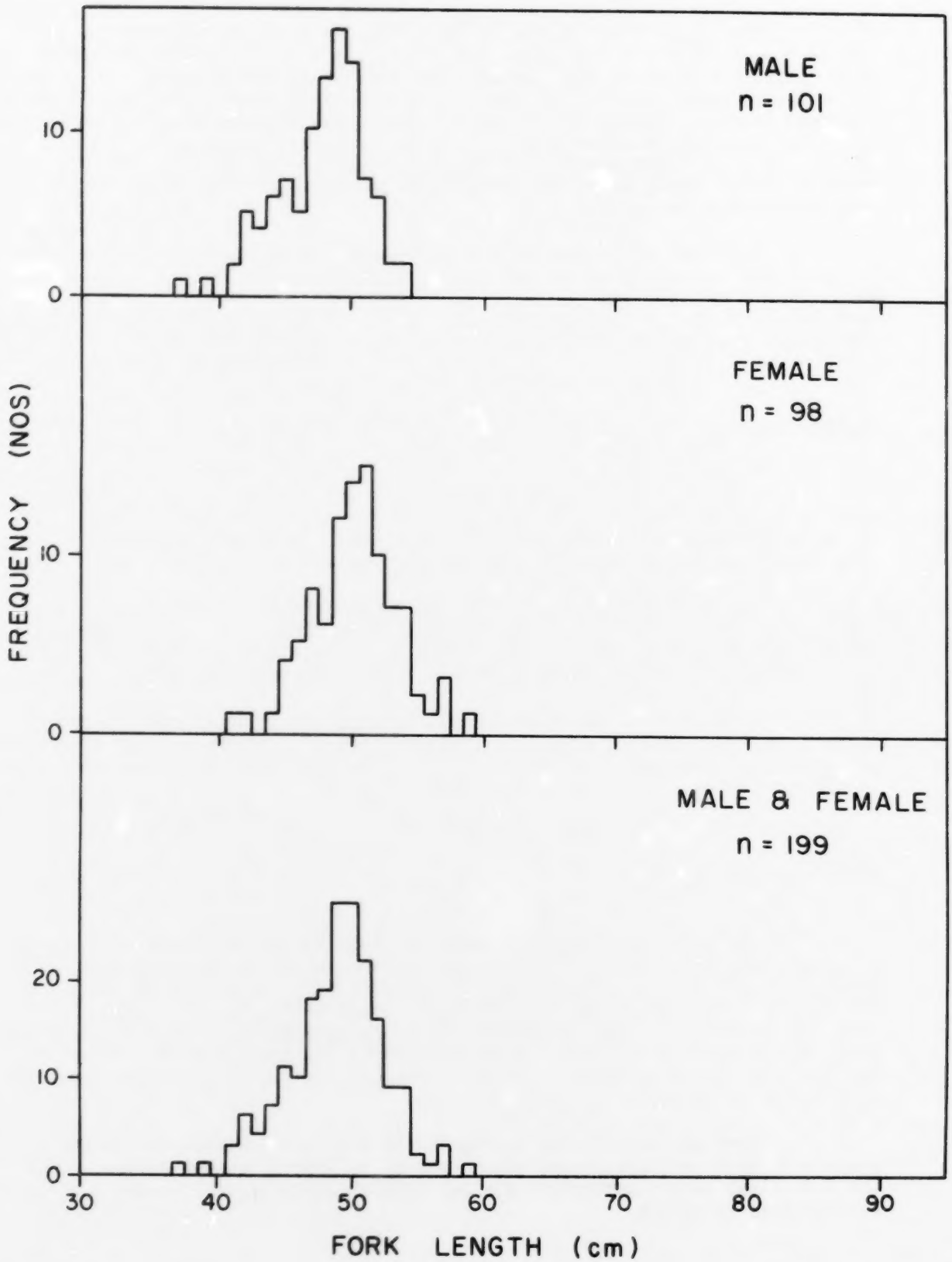


Fig. 30. Length-sex frequency of sablefish sampled off the west coast of Vancouver Island. November 1981.

Fig. 31. Length-sex frequency of sablefish sampled in Hecate Strait. August 1981.


MALE
n = 101
FEMALE
n = 98
MALE & FEMALE
n = 199
FREQUENCY (NOS)
FORK LENGTH (cm)
0
10
20
30
40
50
60
70
80
90

The length distribution of sablefish captured off Vancouver Island ranged from 42-91 cm in 1980 (Fig. 26) and 43-113 cm in 1981 (Fig. 30). The mean length for males in 1981 was 62.2 cm, similar to the observed mean length for males in other areas. Less than 10% of the males were larger than 70 cm. The mean length of females off Vancouver Island was 70.6 cm, slightly smaller than that reported in other areas. Only 46.1% of the females were larger than 70 cm. This is slightly different than reported for the same area in 1979 (Beamish et al. 1980) where less than 1% of the males and 58% of the females were larger than 70 cm.

The length distribution of trawl-caught sablefish in Queen Charlotte Sound ranged from 36-68 cm in 1980 (Fig. 24) and 37-59 in 1981 (Fig. 31). Mean lengths for 1980 and 1981 were 46.4 cm and 49.3 cm, respectively. The 1980 survey in the inlet areas (Fig. 25) contained some adults which increased the length distribution to 45-97 cm with a mean length of 58.9 cm.

STOMACH ANALYSIS

A total of 1948 blackcod captured in the coastal inlets and off the west coast of British Columbia were examined for stomach contents. The volume of contents was measured and a general description was recorded. Sixty-three percent of the fish examined had empty stomachs (Table 26).

The major food items in fish <55 cm were Pacific herring (47%) and euphausiids (24%). Of fish >55 cm the major food items were squid (38%) and Pacific herring (24%). The average volume of stomach contents of all fish was 3.7 cc or 10.2 cc if only those fish with food items were considered.

It is of interest to note that the majority of squid identified in stomach samples were from sablefish captured in inside waters and the majority of Pacific herring identified in stomach samples were from sablefish captured in offshore waters.

ESCAPE DEVICES

A total of 117 traps were used to study the effectiveness of 2 types of escape panels. A one-way analysis of variance of three separate sets (Table 27) indicated a significant difference ($P<0.03$) between catch per trap and type of escape mechanism incorporated. Traps with a 12-in escape (Fig. 32) panel showed 98% escapement and traps equipped with an 8-in slash (Fig. 32) showed 47% escapement when compared to the traps with no escape devices. Mortality appeared to increase exponentially with time from 3% at 10 days to 53% at 15 days.

There was no difference between the size of fish retained in the traps with an 8-in slash escape device and those with no escape device. Thus the 8-in slash escape mechanisms did not selectively allow fish under a certain size to escape.

Table 26. Sablefish stomach samples collected during the 1980 tagging cruises off the B.C. coast.

	Blackcod <55 cm (fork length)	Blackcod ≥55 cm (fork length)	Total
Number examined	817	1,131	1,948
Number empty	414	821	1,235
FOOD ITEM	Volume cc	Volume cc	Volume cc
Pacific herring	1,751	866	2,617
Fish remains (unidentified)	277	828	1,105
Rockfish (Sp.)	40	40	80
Squid	267	1,271	1,538
Squid beaks	34	118	152
Digested organic matter	238	117	355
Octopus	1	31	32
Spider crab	0	50	50
Crab (unidentified)	1	0	1
Sea mouse	42	0	42
Shrimp (unidentified)	24	19	43
Euphausiids	904	62	966
Amphipods	63	80	143
Jellyfish (unidentified)	40	0	40
Sponge	3	0	3
Kelp	25	53	78
Gravel	-	5	5

Table 27. Summary of sablefish caught in traps equipped with experimental escape mechanisms.

No. of traps	Escape device	Soak hours	No. of live fish	x length (cm)	No. of dead fish	x length (cm)	Total fish	x length (cm)
				Set 1--March 12-27, 1981				
20	12"	358.0	0	-	0	-	0	-
14	8"		9	64.7	16	51.6	25	56.1
18	no escape device		80	66.9	84	52.9	164	59.7
				Set 2--June 11-21, 1981				
10	12"	234.5	3	72.1	0	-	3	72.1
10	8"		55	67.4	0	-	55	67.4
10	no escape device		98	67.3	5	47.7	103	67.0
				Set 3--June 11-21, 1981				
10	12"	355.5	0	-	0	-	0	-
9	8"		40	70.5	16	60.1	56	67.5
10	no escape device		68	72.5	26	70.0	94	71.8

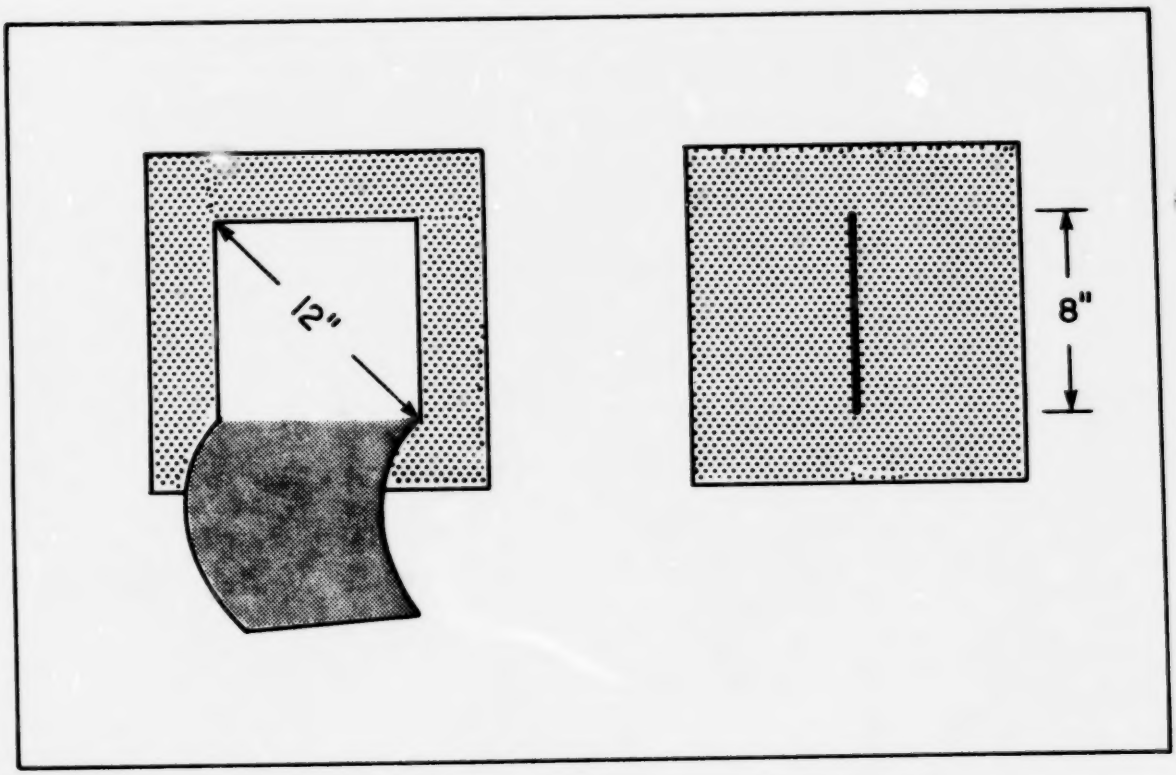


Fig. 32. Experimental escape devices incorporated into sablefish traps. Left: 12-in escape panel. Right: 8-in slash.

Table 28. Summary of species sampled, other than sablefish, during 1980-1981 tagging cruises.

Cruise	Species	Type of sample taken					Kept for lab
		Length	Sex	Maturity	Age	Stomach contents	
February 1980, Queen Charlotte Islands	Spiny dogfish	26	26				
	Lingcod	2	2	2			
	Aurora rockfish	1	1	1	1	1	
	Bocaccio	1	1	1	1	1	
	Redbanded rockfish	6	6	6	3	3	
	Rougheye rockfish	16	16	16	16		
	Shortraker rockfish	80	80	80	80	78	
	Rattails-*Coryphaenoides acrolepis*	44	44	37	44	24	1
	C. armatus	5	3		3	4	2
	C. filifera	1	1	1	1	1	1
	C. pectoralis	9	9	9	9	9	
	Pacific flatnose	11	11	11	10	9	
	Prowfish-*Parabassiogigas grandis*						3
	Unidentified eelpouts						4
March 1980, Queen Charlotte Sound	Rougheye rockfish	5	5	5			
May 1980, Coastal Inlets	Spiny dogfish		45				
	Pacific halibut	11					
	Dover sole	5					
	Turbot	2					
	Darkblotched rockfish	6					
	Redbanded rockfish	10					
	Rougheye rockfish	1					
	Yelloweye rockfish	5	4	4			
	Walleye pollock	10	7	7		1	
	Blackfin sculpin						1

Table 28 (cont'd)

Cruise	Species	Type of sample taken					Kept for lab
		Length	Sex	Maturity	Age	Stomach contents	
July 1980, Queen Charlotte Islands	Rattails-*Coryphaenoides acrolepis*	27	28	28	28		
	C. pectoralis	75	75	75	75		
	Pacific flatnose	1			1		
March 1981, Queen Charlotte Islands	Lingcod	6					
	Pacific halibut	12	12	12	12		
	Rattails-*Coryphaenoides filifera*	21	21	21	21		
	C. pectoralis	2	2	2	2		
	Pacific flatnose	1	1	1			
June 1981, Queen Charlotte Islands	Turbot	5					
	Rattails-*Coryphaenoides* sp. (Juv.)						1
	C. acrolepis	1	1	1	1		
	C. pectoralis	9	9	9	9		
	Pacific flatnose	1	1	1	1		
	Unidentified snailfish						1
August 1981, Queen Charlotte Sound-Hecate Strait	Walleye pollock	396	396				
	Pacific halibut	2	2		2		
	Dover sole	120	120		70		
	English sole	60	60		60		
	Pacific ocean perch	70	70		70		

OTHER SPECIES

A summary of other species sampled during 1980 and 1981 is presented in Table 28.

ACKNOWLEDGMENTS

This study is an integral part of the development of a management strategy for blackcod. The enthusiastic participation of fishermen and industry means that the management of blackcod is truly a cooperative effort.

It is not possible to list all those that have given us samples, returned tagged whole fish with individual exact locations or taken our staff with them on their trips, but we sincerely thank them for their efforts. We also thank a number of shore workers who have made special efforts to find and return tags.

Skippers of charter vessels during 1980 and 1981 were extremely helpful--Ken Winston, M/V TALAPUS; Chris Hummel, M/V LA PORSCHE; Fred Stickland, M/V WESTERLY WIND; Egil Elvan, M/V VIKING STAR; Al Marsden, M/V PACIFIC TRIDENT; Pierre Cote, M/V LaPOINTE; Bruce Iverson, M/V SEAPAK; and Blair Pearl, M/V OCEAN PEARL.

During 1980 and 1981, Blair Pearl, Chris Hummel, Ray Keelan, "The Farringtons", and Inge Noringseth, provided valuable advice and assistance, sometimes at their own expense.

Mr. Duane Rodman of the U.S.A. National Marine Fisheries Service, Takashi Sasaki of Japan Fisheries Agency and Ki Young Kim of Korean Fisheries Agency have kindly returned marked fish recaptured by their fishermen.

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Appendix Table 1. Numbers and identification of tags on sablefish released at different locations off the west coast of the Queen Charlotte Islands, January 25-February 29, 1980.

Release date	Set no.	Location	Anchor tags		Suture tags		Cumulative totals	
			Identification no. B81-[a]	No. released	Identification no. B77-[a]	No. released with double tags	Anchor tags	Anchor & suture tags
Jan 27	3	off Tasu Sound	39000-39074	66	-	0	66	-
28	4	"	39075-39234	149	-	0	215	-
	5	"	39235-39313	76	68348-68365	18	291	18
Feb 1	7	"	39314-39402	88	-	0	379	18
6	10	off Gowgaia Bay	39404-39441	37	-	0	416	18
7	11	"	39442-39533	92	68366-68373	7	508	25
8	12	"	39534-39595	62	68375-68399	25	570	50
	13	"	39596-39612	16	-	0	586	50
9	14	"	39702-39731	30	68400-68419	20	616	70
	15	"	39613-39701	89	-	0	705	70
14	16	off Frederick Is.	39732-39855	116	-	0	821	70
15	18	"	39856-39865	8	-	0	829	70
18	20	off Selveson Pt.	96054-96097	39	-	0	868	70

Appendix Table 1 (cont'd)

Release date	Set no.	Location	Anchor tags		Suture tags		Cumulative totals	
			Identification no. B81-[a]	No. released	Identification no. B77-[a]	No. released with double tags	Anchor tags	Anchor & suture tags
17	21	off Tasu Sound	39887-39999	108	-	0	976	70
	22	"	39866-39886	20	-	0	996	70
19	23	off Kunaken Pt.	96098-96204	101	-	0	1097	70
20	25	off Cartwright Sd.	96292-96370	79	68420-68443	24	1176	94
21	27	off Tasu Sd.	96371-96374 96400-96405	10	68444-68453	10	1186	104
22	28	off Gowgaia Bay	96406-96476	71	-	0	1257	104
	29	"	96477-96553	77	-	0	1334	104
25	30	"	96554-96629	74	-	0	1408	104
27	32	off Flamingo Inlet	96630-96772	130	-	0	1538	104

[a]Identification numbers include some unused tags.

Appendix Table 2. Numbers and identification of tags released at different locations off the west coast of Vancouver Island, March 17-30, 1980.

Release date	Set no.	Location	Anchor tags		Suture tags		Cumulative totals	
			Identification no. B77-[a]	No. released	Identification no. B77-[a]	No. released with double tags	Anchor tags	Anchor & suture tags
Mar 19	1	Off Brooks Bay	97000-97499	494			494	
	2	"	97500-97802	303			797	
20	3	"	97803-98400	597			1394	
	4	"	98401-98639	239			1633	
21	5	"	98640-98935	297	69000-69015	16	1930	16
	6	"	98936-99144	206	69016-69037	22	2136	38
23	7	"	99145-99521	375			2511	
	8	"	99522-99693	172	69038-69039	2	2683	40
24	9	"	99694-99875	182	69040-69052	13	2865	53
25	10	"	99876-99999 40000-40213	335	69053-69161	109	3200	162
26	11	Off San Josef Bay	40214-40630	417	69162-69166	5	3617	167
	12	"	40631-40986	356			3973	

Appendix Table 2 (cont'd)

Release date	Set no.	Location	Anchor tags		Suture tags		Cumulative totals	
			Identification no. B77-[a]	No. released	Identification no. B77-[a]	No. released with double tags	Anchor tags	Anchor & suture tags
Mar 27	13	Off San Josef Bay	40987-40999 B81- 00000-00191	205	69167-69200	34	4178	201
28	14	"	00192-00319	128	69201-69329	128	4306	329
29	15	"	00320-00721	400	69330-69390	59	4706	388

[a]Identification numbers include some unused tags.

Appendix Table 3. Numbers and identification of tags on sablefish released at different locations in Queen Charlotte Sound, March 19-29, 1980.

Release date	Set no.	Location	Anchor tags		Suture tags		Cumulative totals	
			Identification no. B81-[a]	No. released	Identification no. B77-[a]	No. released with double tags	Anchor tags	Anchor & suture tags
Mar 20	1	between Triangle Is. & Cape St. James	01000-01126	121	-	0	121	0
	2	"	01127-01251	121	-	0	242	0
21	3	"	01252-01424	162	68455-68462	8	404	8
	4	"	01425-01515	88	68463-68500	38	492	46
22	5	"	01516-01726	206	-	0	698	46
	6	"	01759-01774 02000-02311	319	-	0	1017	46
	7	"	01727-01758	31	68501-68506	6	1048	52
23	8	"	02312-02521	209	68507-68542	35	1257	87
	9	"	02522-02826	295	68543-68620	77	1552	164
24	10	"	02827-03062	224	-	0	1776	164
25	11	"	03540-03910	355	-	0	2131	164
	12	"	03063-03539	467	-	0	2598	164
26	13	"	03911-03997	83	68622-68656	35	2681	199
27	14	"	03998-04247	244	68657-68675	17	2925	216
29	15	"	04248-04438	187	68676-68767	92	3112	308

[a] Identification numbers include some unused tags.

Appendix Table 4. Numbers and identification of tags on sablefish released at different locations in the major inlets of the British Columbia coast, May 5-15, 1980.

Release date	Set no.	Location	Anchor tags		Suture tags		Cumulative totals	
			Identification no. B81-[a]	No. released	Identification no. B77-[a]	No. released with double tags	Anchor tags	Anchor & suture tags
May 5	1	Fisher Channel	04439-04696	256	68768-68795	28	256	28
6	2	Finlayson Channel	04697-04725	28	-	0	284	28
7	3	"	04726-04999 05500-05782	547	68796-68873	78	831	106
	4	"	05783-05999 05000-05416	609	68874-68926	52	1440	158
8	5	"	05417-05499 27000-27548	609	68927-68999	73	2049	231
9	6	"	27549-28132	575	69391-69475	83	2624	314
	7	"	28133-29371	1174	-	0	3798	314
10	8	Mathieson Channel	29372-29499	121	-	0	3919	314
11	9	"	29500-29574	70	-	0	3989	314
	10	"	29575-29665	87	-	0	4076	314
	13	Ursula Channel	29666-30902	1224	69476-69548	70	5300	384
14	12	Whale Channel	30903-31944	1022	69549-69617	69	6322	453
15	13	Douglas Channel	31945-32644	700	69618-69690	73	7022	526

[a]Identification numbers include some unused tags.

Appendix Table 5. Numbers and identification of tags on sablefish released at different locations off the west coast of the Queen Charlotte Islands and Dixon Entrance, June 28-July 9, 1980.

			Anchor tags		Suture tags		Cumulative totals	
Release date	Set no.	Location	Identification no. B81-[a]	No. released	Identification no. B77-[a]	No. released with double tags	Anchor tags	Anchor & suture tags
Jun 29	1	off Englefield Bay	32645-32699	54	-	0	54	0
	2	"	32700-32781	79	-	0	133	0
	3	"	32782-32852	69	-	0	202	0
30	4	"	32853-32956	95	69691-69703	12	297	12
	5	"	32957-33012	52	69704-69728	24	349	36
	6	off Buck Pt.	33013-33137	124	69729-69741	13	473	49
July 1	7	"	33139-33242	103	-	0	576	49
	8	"	33243-33322	80	-	0	656	49
2	9	off Cartwright Sd.	33323-33463	139	69742-69769	28	795	77
	10	"	33464-33606	142	69770-69787	18	937	95
	11	"	33607-33734	126	69788-69808	21	1063	116
3	12	"	33735-33839	105	69809-69820	12	1168	128
	13	off Hunter Pt.	33840-33899	57	69821-69832	12	1225	140
	14	off Kano Inlet	33900-34030	130	69833-69838	6	1355	146

Appendix Table 5 (cont'd)

Release date	Set no.	Location	Anchor tags		Suture tags		Cumulative totals	
			Identification no. B81-a	No. released	Identification no. B77-a	No. released with double tags	Anchor tags	Anchor & suture tags
July 4	15	off Tian Head	34031-34101	69	69840-69850	11	1424	157
	16	"	34102-34169	68	69851-69855	5	1492	162
	17	"	34170-34240	69	69856	1	1561	163
5	18	off NW corner Graham Is.	34241-34296	54	69857-69872	16	1615	179
	19	"	34297-34375	78	-	0	1693	179
	20	"	34376-34460	84	69873-69883	11	1777	190
6	22	"	34461-34470	10	-	0	1787	190
	23	"	34471-34509	39	-	0	1826	190
	24	"	34510-34561	52	69884-69897	14	1878	204
7	25	"	34562-34646	85	69898-69906	9	1963	213
	26	"	34647-34707	61	-	0	2024	213
	27	"	34708-34764	57	69907-69920	14	2081	227
8	28	Dixon Entrance	34765-34882	116	69921-69935	15	2197	242
	29	"	34883-35005	123	69936-69948	12	2320	254

Appendix Table 5 (cont'd)

Release date	Set no.	Location	Anchor tags		Suture tags		Cumulative totals	
			Identification no. B81-[a]	No. released	Identification no. B77-[a]	No. released with double tags	Anchor tags	Anchor & suture tags
July 8	30	Dixon Entrance	35006-35131	124	69949-69963	15	2444	269
9	31	"	35132-35237	103	69964-69975	12	2547	281

[a]Identification numbers include some unused tags.

Appendix Table 6. Numbers and identification of tags on sablefish released at different locations in Hecate Strait and Queen Charlotte Sound, Sept-Oct 1980.

Release date	Set no.	Location	Anchor tags		Suture tags		Cumulative totals	
			Identification no. B81-[a]	No. released	Identification no. B77-[a]	No. released with double tags	Anchor tags	Anchor & suture tags
Sept 23	2,3	White Rocks	35238-35682	416	69977-70038	60	416	60
24	4	"	35683-36136	426	70039-70117	79	842	139
	5	"	36137-36671	507	70118-70207	89	1349	228
	6	"	36672-37097	415	70208-70267	59	1764	287
	7	"	37098-37133	6	-	-	1770	287
25	8	"	37134-37187	53	70274-70282	9	1823	296
	9	"	37188-37633	437	70283-70340	58	2260	354
	10	"	37634-37988	344	70341-70396	55	2604	409
	11	"	37989-38095	106	70397-70411	15	2710	424
	12	"	38096-38139	43	70412-70417	6	2753	430
	13	"	-	-	70418-70425	8	2753	438
	14	"	38140-38231	91	70426-70434	9	2844	447
	15	"	38232-38363	131	70435-70446	12	2975	459

Appendix Table 6 (cont'd)

Release date	Set no.	Location	Anchor tags		Suture tags		Cumulative totals	
			Identification no. B81-[a]	No. released	Identification no. B77-[a]	No. released with double tags	Anchor tags	Anchor & suture tags
Sept 26	16	White Rocks	38364-38528	164	70447-70467	20	3139	479
	17	"	38529-38665	135	70468-70487	19	3274	498
	18	"	38666-38830	163	70488-70509	22	3437	520
	19	"	38831-39048	212	70510-70531	22	3649	542
	20	"	39049-39142	87	70532-70544	13	3736	555
	22	"	39143-39178	34	70545-70550	6	3770	561
	23	"	39179-39341	155	70551-70570	20	3925	581
	24	"	39342-39568	213	70571-70604	34	4138	615
	25	"	39569-39947	363	70605-70643	39	4501	654
29	34,35	NE corner Goose Is. Ground	39948-39995	47	-	-	4548	654
30	36	SE corner Goose Is. Ground	39996-40212	208	70644-70668	25	4756	679
	42	"	40213-40310	97	70669-70680	12	4853	691
	47	"	40311-40351	40	-	-	4893	691

Appendix Table 6 (cont'd)

Release date	Set no.	Location	Anchor tags		Suture tags		Cumulative totals	
			Identification no. B81-[a]	No. released	Identification no. B77-[a]	No. released with double tags	Anchor tags	Anchor & suture tags
Oct 1	52	SE corner Goose Is. Ground	40352-40396	45	-	-	4938	691
2	53	White Rocks	40397-40646	240	70682-70705	24	5178	715
	54	"	40647-40849	195	70706-70727	20	5373	735
	55	"	40850-40948	92	70728-70740	13	5465	748
	56	"	40949-41332	360	70741-70781	40	5825	788
	57	"	41333-41845	491	70782-70837	56	6316	844
	58	"	41846-42090	237	70838-70865	27	6553	871
	59	"	42091-42570	455	70866-70918	52	7008	923
3	60	"	42571-42803	232	70919-70946	28	7240	951
	61	"	42804-43350	539	70947-71021	76	7779	1027
	62	"	43351-43999 48000-48008	645	71022-71095	72	8424	1099
	63	"	48009-48165	152	71096-71108	13	8576	1112
	64	"	48166-48728	554	71109-71169	61	9130	1173

Appendix Table 6 (cont'd)

Release date	Set no.	Location	Anchor tags		Suture tags		Cumulative totals	
			Identification no. B81-[a]	No. released	Identification no. B77-[a]	No. released with double tags	Anchor tags	Anchor & suture tags
Oct 4	65	White Rocks	48729-48912	184	71170-71186	17	9314	1190
	66	"	48913-49105	191	71187-71206	20	9505	1210
	67	"	49106-49296	189	71207-71226	20	9694	1230
	68	"	49297-49323	27	-	-	9721	1230
	69	"	49324-49508	177	71227-71247	21	9898	1251

[a]Identification numbers include some unused tags.

Appendix Table 7. Numbers and identification of tags on sablefish released at different locations off the west coast of the Queen Charlotte Islands, March 1981.

Release date	Set no.	Location	Anchor tags identification number B81-∞	Number released	Cumulative number released
Mar 27	1	off Englefield Bay	79037-79142	106	106
15	2	"	76000-76337	338	444
16	3	off Buck Channel	76338-76587	249	693
	4	off Englefield Bay	76588-76839	251	944
17	5	off Cartwright Sd.	76840-77206	366	1310
18	6	off Kano Inlet	77207-77425	219	1529
19	7	off Bottle Inlet	77426-77644	218	1747
	8	off Kootenay Inlet	77645-77763	119	1866
20	9	off Tasu Sd.	77764-78047	284	2150
21	10	South of Tasu Sd.	78048-78411	364	2514
23	11	off Pocket Inlet	78412-78743	306	2820
25	12	off Tasu Sd.	78744-78899	156	2976
26	13	off Kootenay Inlet	78900-78965	66	3042
27	14	North of Tasu Sd.	78966-79036	71	3113

∞Identification numbers include some unused tags.

Appendix Table 8. Numbers and identification of tags on sablefish released at different locations off the west coast of the Queen Charlotte Islands, June 1981.

Release date	Set no.	Location	Anchor tags identification number B81-∞	Number released	Cumulative number released
June 12	1	N. of Tasu Sd.	79143-79240	98	98
	2	off Kootenay Inlet	79241-79329	89	187
21	3	off Bottle Inlet	80782-80936	155	342
25	4	"	81653-81762	108	450
13	5	S. of Tasu Sd.	79330-79489	160	610
	6	off Tasu Sd.	79490-79578	89	699
14	7	S. of Tasu Sd.	79579-79782	203	902
15	8	off Sunday Inlet	79819-80051	233	1135
	9	"	79783-79818	36	1171
16	10	off Barry Inlet	80052-80170	119	1290
	11	"	80171-80268	98	1388
17	12	off Mike Inlet	80269-80334	66	1454
	13	"	80335-80437	103	1557
19	14	off Englefield Bay	80438-80555	118	1675
	15	"	80556-80621	66	1741
20	16	"	80622-80685	64	1805
	17	off Kano Inlet	80686-80781	96	1901
22	18	S. of Tasu Sd.	80937-81114	178	2079
	19	"	81115-81313	199	2278
23	20	"	81314-81321	8	2286
24	21	off Barry Inlet	81322-81473	150	2436
	22	S. of Tasu Sd.	81474-81652	179	2615
25	23	off Sunday Inlet	81763-81999 72000-72055	293	2908

∞Identification numbers include some unused tags.

Appendix Table 9. Numbers and identification of tags on sablefish released at different locations in Hecate Strait and Queen Charlotte Sound, August 1981.

Release date	Set no.	Location	Anchor tags identification number B81-[a]	Number released	Cumulative number released
Aug 14	1	North Moresby Gully	44000-44091	92	92
	2	"	44092-44152	60	152
	3	"	44153-44218	66	218
	4	"	44219-44370	138	356
	5	"	44371-44439	56	412
15	6	White Rocks	44440-44772 44775-44788	341	753
	7	"	44773-44774 44789-45245	448	1201
	8	"	45246-45966	714	1915
16	9	"	45967-46046	79	1994
	10	"	46047-46102	56	2050
	11	"	46103-46237	134	2184
	12	"	46238-47047	799	2983
17	13	NE edge, Goose Is. Bk.	47048-47060	13	2996
	15	"	47061-47099	36	3032
18	19	SE edge, Goose Is. Bk.	47100-47920	815	3847
	21	"	47921-47999 49509-49833	400	4247
	22	"	49834-49948	115	4362
19	23	"	49949-50186	238	4600
	24	"	50187-50266	78	4678
	25	"	50267-50313	47	4725

Appendix Table 9 (cont'd)

Release date	Set no.	Location	Anchor tags identification number B81-[a]	Number released	Cumulative number released
Aug 19	26	SE edge, Goose Is. Bk.	50314-50398	84	4809
	28	"	50399-51152	753	5562
20	29	"	51153-51534	379	5941
21	33	"	51535-51700	159	6100
22	34	"	51701-52051 52075-52099	372	6472
	35	"	52052-52074 52100-52687 52700-52708	617	7089
	36	"	52688-52699 52709-52971	275	7364
	37	"	52972-53234	256	7620
24	38	"	53235-53549	309	7929
	39	"	53550-53896 53900-53924	370	8299
	40	"	53897-53899 53925-54307	386	8685
	41	"	54308-54680	372	9057
	42	"	54681-54899 54925-54944 54950-54957	245	9302
25	43	"	54900-54924 54945-54949 54958-55126	194	9496
	44	"	55127-55505	376	9872
	45	"	55506-55709	204	10,076
	46	"	55710-55899 55950-55978	218	10,294

Appendix Table 9 (cont'd)

Release date	Set no.	Location	Anchor tags identification number B81-[a]	Number released	Cumulative number released
Aug 25	47	SE edge, Goose Is. Bk.	55900-55906 55979-55999	28	10,322
	48	"	55907-55949 56000-56164 56175-56177	209	10,531
	48	"	55907-55949 56000-56164 56175-56177	209	10,531
26	49	"	56165-56174 56178-56585	416	10,947
	50	"	56586-56880	292	11,239
	51	"	56881-56999 72056-72267	328	11,567
	52	"	72268-72583	315	11,882
	53	"	72584-72702	119	12,001
	54	"	72703-72905	194	12,195
	55	"	72906-73017	111	12,306

[a]Identification numbers include some unused tags.

Appendix Table 10. Numbers and identification of tags on sablefish released at different locations off the west coast of the Queen Charlotte Islands, November 1981.

Release date	Set no.	Location	Anchor tags identification number B81-∞	Number released	Cummulative number released
Nov 25	1	off Cape Henry	73048-73207	149	149
	2	"	73208-73374	167	316
	3	off Buck Point	73375-73399	25	341
26	4	"	73400-73582	181	522
	5	off Englefield Bay	73583-73836	254	776
	6	"	73837-74137	300	1,076
27	7	off Buck Pt.	74138-74345	208	1,284
	8	"	74346-74527	182	1,466
	9	"	74528-74728	201	1,667
	10	"	74729-75001	273	1,940
	11	"	75002-75277	276	2,216
	12	"	75278-75579	302	2,518
Nov 28	13	off Marble Is.	75580-75824	245	2,763
	14	"	75825-75999		
			B82-∞		
			22000-22080	256	3,019
	15	"	22081-22215	134	3,153
	16	"	22216-22427	211	3,364
29	17	off Kano Inlet	22428-22647	219	3,583
	18	"	22648-22799	152	3,735
	19	"	22800-23013	214	3,949
	20	"	23014-23222	203	4,152
	21	off Kennell Sd.	23223-23481	258	4,410

∞Identification numbers include some unused tags.

Appendix Table 10A. Summary of OTC injections given to tagged sablefish off the west coast Queen Charlotte Islands, November 1981.

Set no.	No. of fish released									
	"00"		"P1"		"P2"		"P3"		"M1"	
	No.	Cum. no.	No.	Cum. no.	No.	Cum. no.	no.	cum. no.	no.	cum. no.
1	50	50	-	-	-	-	99	99	-	-
2	-	50	67	67	100	100	-	99	-	-
3	-	50	25	92	-	100	-	99	-	-
4	48	98	7	99	26	126	100	199	-	-
5	51	149	100	199	74	200	29	228	-	-
6	30	179	100	299	100	300	70	298	-	-
7	20	199	-	299	88	388	100	398	-	-
8	50	249	100	399	13	401	19	417	-	-
9	-	249	20	419	100	501	81	498	-	-
10	49	298	74	493	50	551	100	598	-	-
11	51	349	99	592	60	611	66	664	-	-
12	50	399	100	692	100	711	52	716	-	-
13	-	399	63	755	100	811	82	798	-	-
14	50	449	36	791	70	881	100	898	-	-
15	5	454	99	890	30	911	-	898	-	-
16	32	486	-	890	79	990	100	998	-	-
17	48	534	100	990	21	1011	-	998	50	50
18	2	536	-	990	-	-	50	1048	100	150
19	-	-	10	1000	-	-	24	1072	180	330
20	-	-	84	1084	-	-	-	-	119	449
21	-	-	100	1184	-	-	-	-	158	607

"00"-No injection
"P1"-25 mg/kg body wt.
"P2"-50 mg/kg body wt.
"P3"-75 mg/kg body wt.
"P"-Injection intraperitoneal
"M"-Injection intermuscular
"M1"-25 mg/kg body wt.

POOR

QUALITY

ORIGINAL